TITAN

AIR INCORPORATED

OPERATING AND SERVICE MANUAL

Serial Number: _____

For technical service or repair,

FIRST CALL - INSTALLING CONTRACTOR:

WARRANTY

24 MONTH WARRANTY

Titan Air, Inc. hereby warrants its products against defects in material and workmanship for a period of (24) twenty four months from date of shipment.

Warranty sheet is due back within (30) thirty days of start-up for 24 month warranty to be effective. After (30) thirty days, and up until (60) sixty days, a (12) twelve month warranty will be observed. All warranties are null and void if warranty sheet is not received within (60) sixty days from start-up. NO EXCEPTIONS WILL BE MADE.

Titan Air, Inc. reserves the right at Titan Air, Inc.'s option, to replace or repair free of charge, any part proven by Titan Air, Inc. to be defective. Prompt notification of defective part must be given to Titan Air Inc. and defective part must be returned freight prepaid within (30) days of notification.

WARRANTY INCLUDES ONLY PARTS SUPPLIED BY TITAN AIR, INC. INCIDENTAL COSTS AND LABOR CHARGES SHALL BE THE RESPONSIBILITY OF OTHERS. This warranty does not cover fuses, belts, filters or water damaged parts.

This warranty is void in event the product is improperly installed and/or operated under conditions other than normal published ratings, improperly maintained, misused or not in compliance with applicable codes: or not in accordance with Titan Air, Inc.'s operating instructions.

This warranty is void if attempts to correct or repair any alleged defective part or parts are made by unauthorized personnel without Titan Air, Inc.'s written approval.

In no event shall Titan Air, Inc. be held liable for any damage, incidental or consequential, arising from the installation, performance or operation of the product.

This warranty supersedes, voids and/or is in lieu of any other verbal or written understanding which may not be in total accordance with this expressed warranty.

Warranty parts must be returned to Titan Air Inc. within 60 days to receive credit.

POTENTIAL FOR WATER DAMAGE DUE TO SUMP OVERFLOW

Evaporative coolers installed in a location where sump overflow could cause damage to the building or other equipment must include safety feature #1 and either #2 or #3. Titan Air is NOT responsible for damages that could be caused by sump overflow.

1. Water supply piping must include a flow limiter to ensure that overflow outlet can drain more water than supply line can provide in the event that float valve fails.
2. A field installed overflow safety switch and fill/drain line valves. Install float switch to detect sump water levels slightly above the primary overflow inlet but, below the rim of the evaporative cooler sump. If the float switch actuates, automatic valves on the water supply line (normally closed) and drain line (normally open) must be de-energized. A secondary circuit provides alarm indication.
3. A secondary drain pan that will capture water in the event of a sump overflow and drain the water to an acceptable location. Secondary drain pan must be designed to handle full flow capability of supply line if float valve fails.

PURPOSE / APPLICABILITY

This manual is intended to provide general installation, operating, and service information. Reference materials for a specific evaporative cooler are included at time of shipment . Reference materials include Parts Lists, Electrical Schematic, Sequence of Operation, as well as pump and fill valve manufacturer's documentation. Review the reference materials for a specific unit and note optional components which may not be addressed in this manual prior to start-up or service work.

WARRANTY CHECKLIST

Model:	Serial No.:
Titan Rep.:	Date:
Job Name:	
Address:	
Installing Contractor:	
Signature	

Fill in numbers and / or check applicable items (refer to installation instructions). Return a copy of this sheet to Titan Air to validate warranty. Warranty is void if this sheet is not properly filled-out and returned within 30 days of equipment start-up.

PRESTART STATUS	
120 V GFCI protected power by others	
Low level switch "piggyback" plug in GFCI receptacle.	
Pump plugged in to "piggyback" plug	
Fill, drain & overflow piped properly. No valves on overflow line and overflow pipe size never reduced.	
Fill valve and associated piping properly tightened. Float set and securely tightened.	
Fill/drain valves installed (if applicable)	
Optional controls wired properly	
Cooler level or slight pitch towards drain	
GENERAL OPERATION	
Fill level approx. ½" – 1" below media	
Fill level below overflow inlet	
Float operated fill valve shuts off completely.	
Low level float switch that powers pump is functional	
Pump functional	
Entire media wetted	
No water carry-over	
Powered fill & drain valves functional (if applicable)	
Low temp. drain stat (if applicable)	
Cooling stat (if applicable)	
Dry cycle (if applicable)	
Flush cycle (if applicable)	
Sump overflow safety features installed and tested if overflow could damage equipment or building. See page 1.	

NOTES AND COMMENTS

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Note that operating and service manuals are occasionally requested prior to production of equipment. These manuals will be marked “Pre-Production Release” on the front cover. The final copy of the operating and service manual for a specific unit will be sent with the unit.

GENERAL INFORMATION

The information and recommendations contained in this publication are based on general observation and are not intended to supplant requirements of Federal, State, or local codes having jurisdiction. These codes should be reviewed before installation of Titan Air equipment.

It is the responsibility of the purchaser at the time of order to specify any and all State, local, or insurance agency requirements that may dictate the addition of components to the equipment in order to comply with those requirements.

Only qualified personnel who have experience with the installation and operation of industrial / commercial air handling equipment should attempt to install, start-up, or service Titan Air equipment.

EQUIPMENT ARRIVAL

A. When the transporter delivers the Titan Air equipment, be sure to inspect for damages. The equipment was thoroughly inspected before leaving the factory and the driver has signed for the equipment. Read the bill of lading and verify that the items listed are all present. Any damage or missing items should be reported to the transporter immediately. DO NOT SEND DAMAGED FREIGHT BACK TO TITAN AIR! All claims must be filed with the transporter. Be sure to take photographs and get the drivers signature to confirm the damage. The driver will have a number for you to call in order to file a claim. Request a written inspection report from the claims inspector to substantiate any necessary claim. Be sure to open the unit access doors and inspect for internal damage.

If for some reason you are unable to install the equipment immediately, be sure that the equipment is protected from the elements. Water damaged parts are not covered by Titan Air's warranty. If the equipment is stored for an extended length of time, be sure to completely check over the unit for any internal damage which may have been caused by excessive condensation. Fully lubricate bearings. Also, check for any damage caused by rodents and clean dust that may have built up on components.

CAREFULLY AND THOROUGHLY READ TITAN AIR'S PRODUCT WARRANTY.

B. Because we are not able to simulate exact field conditions and actual conditions can vary from the order, proper field start-up is essential. For this reason, start-up by a qualified technician is mandatory. The warranty checklist must be filled out while the start-up is accomplished. This checklist must be returned to Titan Air to validate the warranty.

C. For a fee, Titan Air personnel will travel to the job site, supervise the start-up, and provide operation and maintenance training.

EVAPORATIVE COOLING MEDIA

Evaporative coolers are available with premium quality rigid, resin-reinforced cellulose media or fiberglass media (UL 900 Class II fire rated). The media is a cross-fluted pad of cellulose or fiberglass material impregnated with anti-rot salts and rigidifying and wetting agents. Media transverse flutes form angles of 15° downward towards the air leaving side of the media and 45° downward towards the air entering side. Steeper flutes towards the air entering side of the media direct more water to the entering face where it is needed the most. Typical 12" deep media has an air pressure drop of 0.25" w.g. at 500 feet per minute face velocity and a saturation efficiency of 89%.

GENERAL INFORMATION

PUMP AND LOW LEVEL FLOAT SWITCH

A submersible pump is placed in the evaporative cooler sump. A low water level switch is used to prevent the pump from running if the sump is not adequately filled.

CABINET

Titan Air evaporative cooler equipment features a stainless steel sump with a galvanized sheet metal cabinet above the sump. Complete stainless steel construction is optional. The galvanized sheet metal cabinet can be provided with a painted or galvanized finish. Standard painting process involves the use of galvanealled (paint lock), sheet metal with an acrylic enamel primer and finish coat. Custom painting processes are available to provide enhanced corrosion protection or color matching.

16 or 18 gauge sheet metal is utilized on exterior sheeting. Galvanized or galvanealled sheet metal features a zinc coating weight of G-90.

Custom configurations with evaporative coolers incorporated into an airhandler or multiple coolers in an “air-house” are available.

OPTIONAL CONTROLS

Controls options include:

1. Automatic fill and drain valves.
2. Low ambient temperature drain thermostat to automatically drain sump.
3. Dry cycle (timer keeps blower running to dry media when unit is shutdown).
4. Flush cycle (runs pump with blower off to flush media followed by dry cycle).
5. Cooling thermostat (enables pump when space or outside air temp. rises).
6. Sump overflow safety switch & alarm (by others).
7. Supply line flow restrictor. Adjustable “circuit setter” type valve can be used. This flow restrictor is field set to ensure that supply flow cannot exceed drain capacity if float valve fails.

INSTALLATION

INSTALLATION

1. Titan Air evaporative coolers should be installed and maintained by experienced HVAC technicians.

2. When locating your Titan Air evaporative cooler, consider access requirements for inspection, maintenance and replacement of the components within the evaporative cooler (pump, fill valve, adjustment valves, media, etc.,). Evaporative cooler should be installed level or with a slight pitch towards the drain end.

3. Both the fill line and drain line should have shut-off valves installed at the cooler (do not valve the overflow line). Refer to the drawings for details regarding relative position of the media, fill valve, full water line, overflow standpipe, bleed line, and drain line. An automatic fill & drain system and/or automatic media flush/dry system are optional with your Titan Air evaporative cooler.

4. **If the equipment is installed in a location where sump overflow could cause damage, overflow safety features must be field installed. Refer to page 1.**

5. Fill line must be flushed PRIOR to connection to evaporative cooler. This cleans out debris that can prevent float operated fill valve from functioning properly. A water line filter is recommended to ensure proper operation of fill valve.

6. Drain and overflow lines must be properly trapped. In many cases, trap depth must account for the negative pressure (suction) in the evaporative cooler cabinet. Traps should be inspected and cleaned as part of a regular maintenance program. Overflow line size should not be reduced.

7. Inlet water pressure should be between 10 psi and 60 psi for proper fill valve operation. Fill valve height must be adjusted so that the water level shut-off point is approximately ½" to 1" below the media and slightly below the overflow inlet. After final water depth adjustment, confirm that all pipe fittings in fill valve line are secure, float adjustment is secure and that fill valve shuts off completely. Diaphragm in fill valve can be cleaned if fill valve does not shut-off completely.

8. A separate GFI protected, 120 VAC, 15 amp power circuit must be supplied for the evaporative cooler pump. Typically, the submersible pump plugs into a "piggyback" plug for a low water level switch to prevent the pump from running dry. If pump and low level float switch are factory wired, the "piggyback" plug may have been removed and both devices may be wired on the load side of a GFI module that does not accept standard plugs.

9. Typically, building air should not be recirculated over the evaporative cooler media. Recirculation can cause a build-up of moisture in the served area. The use of 100% outside air and building relief or exhaust is preferred.

10. Light on the media surface and sump water should be avoided. Light with moisture allows rapid growth of algae.

OPERATION

1. The fill valve float height and associated water level in the sump must be adjusted properly per step 7 above prior to energizing the GFI protected outlet for the low water level switch and pump.

2. *While monitoring sump level to prevent spilling water over top of stainless steel sump, simulate failure of fill valve to allow water to continue flowing into sump and out of the overflow fitting. Adjust water supply line valves/fittings (by others) if necessary to establish a condition where supply flow cannot exceed overflow outlet capacity if float valve fails.*

3. The low water level switch should allow the pump to be energized when the water level in the sump rises above 2.5" to 3.5".

4. For new media, operate the pump without airflow for at least one hour to thoroughly rinse dust and excess resin from the media that accumulates in manufacturing processes. Drain the sump and re-fill prior to operating the pump with airflow. This will minimize any unusual odors that occupants might notice and also minimize foaming in the sump.

5. With the pump operating, adjust the main water flow rate hand valve to obtain a pressure of approximately 2 psi to 4 psi at the pressure gauge above the hand valve. Visually inspect the media on the upstream and downstream sides of the media. The entire media surface should be wetted without water carry-over into the airstream. If water is be entrained into the airstream, the air velocity across the media may be excessive and/or the water flow rate may be excessive. Obtain an air velocity reading and try reducing the water flow rate. Air velocity should not exceed 500 feet per minute without a drift eliminator.

6. A bleed line with adjustment valve allows a constant supply of fresh water for dilution of the recirculated sump water. See water treatment section below. Bleed-off rate must be set with the small hand valve on the bleed line. In addition to guidelines presented below, bleed-off rate should be adjusted based upon specific installation experience.

7. Operation of optional controls should be tested per sequence of operation.

8. A dry cycle (pump off with air flow on) of approximately 30 minutes is recommended following each pump operation. If the evaporative cooler and associated air supply cycle several times per day, only one daily dry cycle is needed. If scale build-up is a problem, the media should be flushed by allowing the pump to operate for one to two hours with no airflow. Follow this flush cycle with a dry down cycle. Timers and valves are available to automate the dry down and flush cycles.

WATER TREATMENT

WATER TREATMENT

1. Proper flow/bleed rates, routine maintenance/cleaning, and regular flushing/drying of the media and water distribution system are the most effective techniques for controlling scale build-up and biological fouling as well as extending media life.

2. In areas with poor water quality or areas where biological fouling particulates are present, consult with a water treatment specialist regarding chemical, ozone, or UV treatment of recirculating water. Water treatment guidelines are provided in Munters Engineering Bulletin EB-0111-WTM. Note that improper chemical treatment can damage the media.

3. The recommended pH of the water should be maintained at a level between 6 and 8. Exceeding these limits will deplete the resin content of the pad and thus reduce its structural integrity.

Titan Air has had good success with a simple water treatment process involving a product called MARS Pan Protector. This is a water soluble time released biocide that will treat the recirculated evaporative water for up to three months. The product is effective against a broad range of mildews, molds, fungi, bacteria and viruses (including legionella bacteria). MARS Pan Protector is a safe time released product that will act as a chemical feeder for your system. It is EPA registered for safety and effectiveness.

Insert the appropriately sized strip in the sump of your unit. Be sure not to interfere with the operation of the float assembly. The strip will time release active agents to kill and prevent microbial activity, reduce corrosion, and counteract odors. Replace the used strip every three months (it will be the same size as when installed), wrap in newspaper and dispose of in everyday trash. Wash hands after use. Note: The instructions that are printed on the MARS packaging are for air conditioner condensate drain pans.

The product is distributed by Motors & Armatures, Inc. (800-445-4155). See the chart below for the appropriate sizing

MODEL	CFM RANGE	MARS Pan Protector Part #
TA-24/24 EV	1 ,000 to 2,000	93285
TA-36/36 EV	2,000 to 4,000	
TA-36/48 EV	3,000 to 6,000	
TA-48/48 EV	5,000 to 8,000	93286
TA-48/60 EV	8,000 to 10,000	
TA-60/60 EV	10,000 to 13,000	
TA-60/72 EV	13,000 to 16,000	93287
TA-72/72 EV	16,000 to 18,000	
TA-72/84 EV	18,000 to 20 ,000	
TA-72 96 EV	20,000 to 22,000	
TA-72/120 EV	22,000 to 30,000	93288

MAINTENANCE

INSPECTION/MAINTENANCE

1. Regular inspection and maintenance of the evaporative cooling equipment will ensure proper service and efficiency from the equipment for years. Establish a routine inspection and maintenance program for the evaporative cooler. A sample inspection sheet is included with the materials shipped with each evaporative cooler.

2. The media and water distribution system should be visually inspected on a regular basis and cleaned or repaired as necessary. Water distribution manifold holes can become plugged with debris resulting in uneven water flow and scale formation. If the media needs replacement, ensure that the new sections are oriented properly (see bulletin 805-OI included with the materials shipped with each evaporative cooler).

3. For significant scaling problems, verify proper water distribution across media face, increase water flow rate, reduce the number of on/off cycles, increase bleed-off rate, or use chemical treatment. For significant algae or biological fouling, completely dry the pads at least once per day, flush the sump, minimize sources of light and nutrients, and/or use chemical, ozone, or UV water treatment.

4. Properly maintained and operating media will help minimize distribution of airborne contaminants. With proper water distribution, the media acts as a self-cleaning filter.

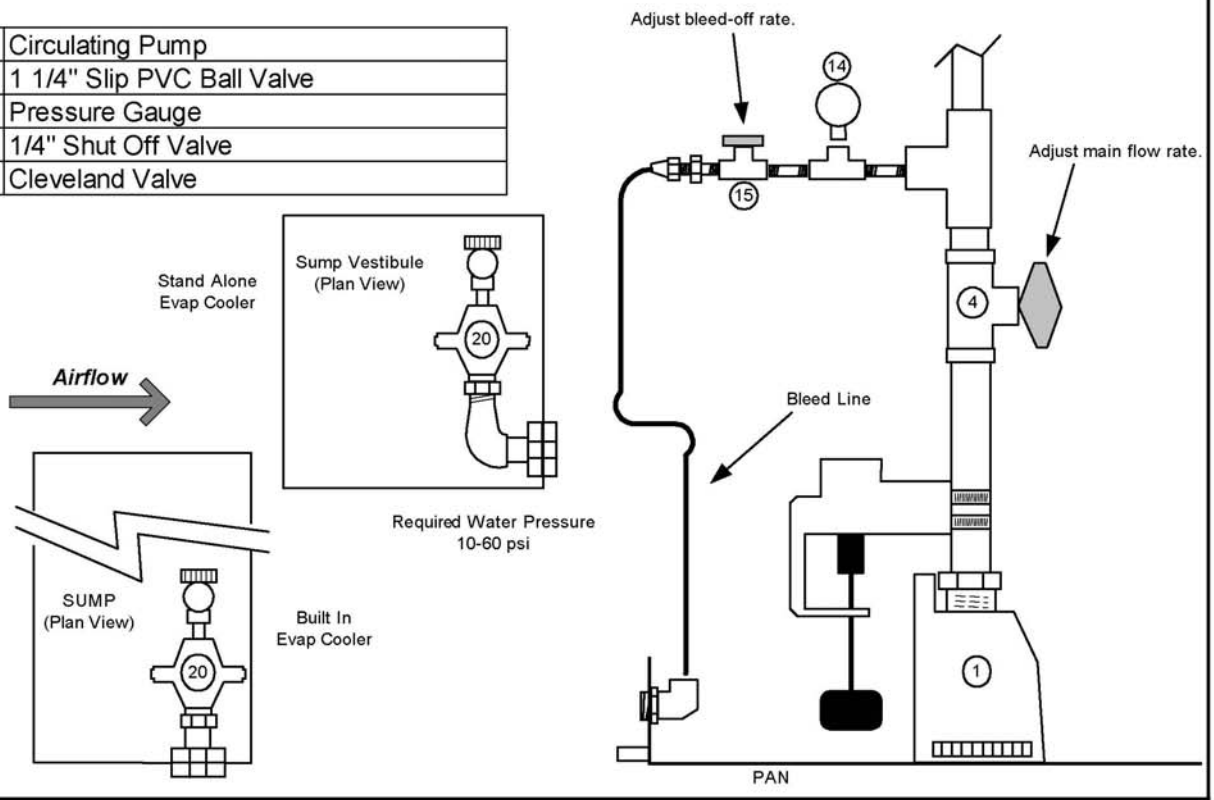
5. Confirm complete shut-off of float operated fill valve.

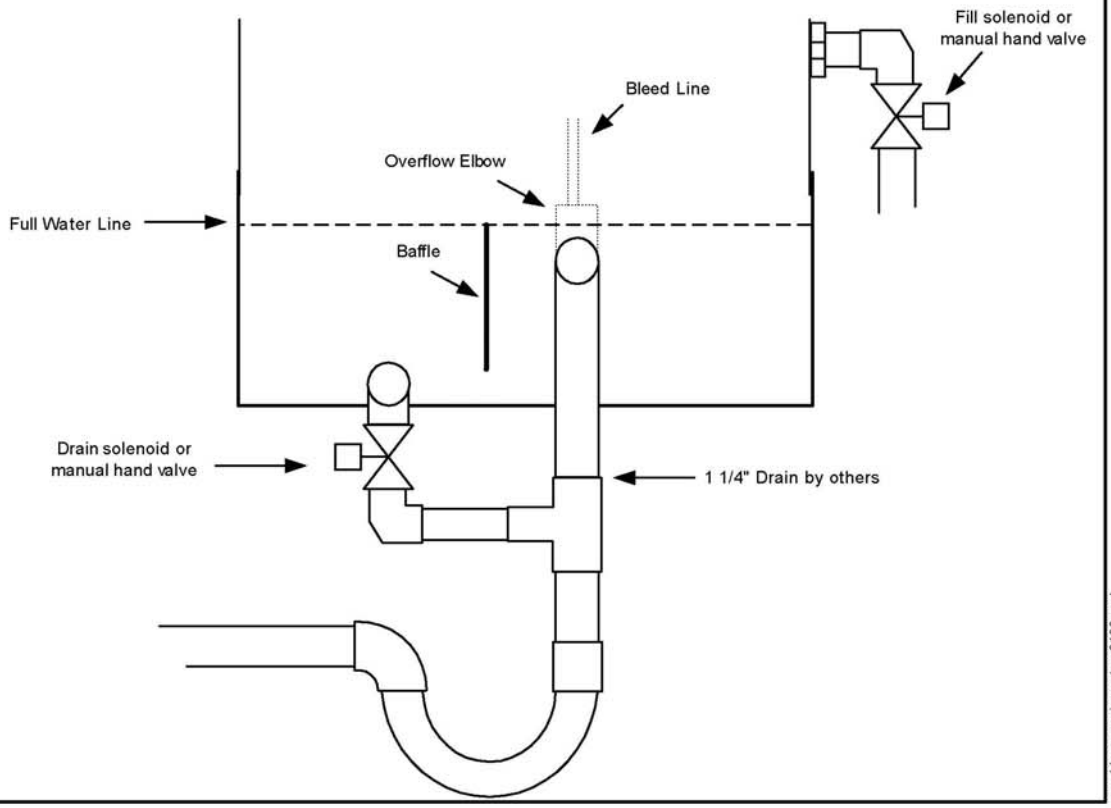
6. Clean drain line/trap and overflow line/trap. If equipment is installed in a location where sump overflow could cause damage, test operation of overflow safety features.

TYPICAL ASSEMBLY DRAWING

TITAN AIR INCORPORATED	Abbreviated Evap Cooler Parts List	JOB: Master	SERIAL NUMBER: ####
			DATE: 01/18/11 DRAWN BY: KK

1	Circulating Pump
4	1 1/4" Slip PVC Ball Valve
14	Pressure Gauge
15	1/4" Shut Off Valve
20	Cleveland Valve





ev abbr generic parts s2100.vsd

MEDIA ORIENTATION INSTRUCTIONS
Engineering Bulletin EB-DOI-0204

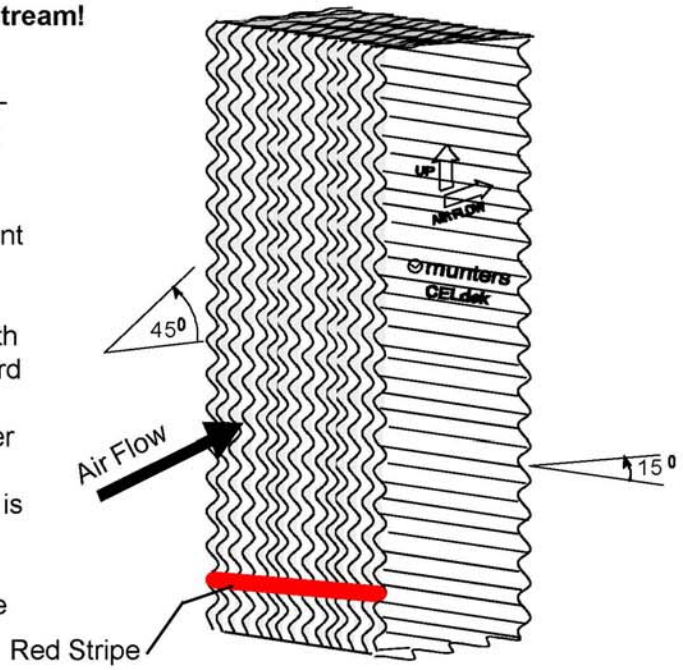
IMPORTANT

Installation

In order to get the best performance from your Munters cooling pads, they must be installed properly. **Improper installation will result in excessive water carryover and possible catastrophic damage to equipment downstream!**

Depending on the application, pads are manufactured special with angle combinations. Those having combinations of 15º x 45º or 30º x 45º are made to direct more water toward the air entering side of the pads. A red stripe indicates the lower front of the upstream face of the pad.

Munters pads must always be installed with the steeper flute angle sloping down toward the air entering side. The reasoning is simple. The steeper angle puts more water on the entering side of the pad where the air is hot, dry, and dusty and extra water it is needed most. The unequal angles also counteract the tendency of the air to push the water toward the air leaving side of the pad.



Caution

Do not expose CELdek® evaporative cooling pads to sparks, open flame, welding spatter, temperatures in excess of 350º F, or other sources which may ignite the paper. New GLASdek® will not readily ignite, unless exposed to a direct flame or extremely high temperatures for an extended period of time.

Test Results for ASTM-E84 Standard Method of Test for Surface Burning Characteristics of Building Materials

PRODUCT	Flame Spread Index	Smoke Density
CELdek®	450	420
GLASdek®	0	20
Mi-T-Dark®, DRIFdek®, & COOLdek®	15	745

The data and suggestions contained herein are based on information Munters believes to be reliable. They are offered in good faith but without guarantee, as conditions and methods of use are beyond our control. We recommend that the prospective user determine the suitability of our media and suggestions before adopting them on a commercial scale.

For more information Contact Munters Corporation, HumiCool Division 239-936-1555

CELdek, GLASdek, Mi-T-Dark, DRIFdek, and PLASdek are registered trademarks of Munters Corporation
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Munters

Engineering Bulletin
EB-HIM-0302

HUMIDIFIER INSPECTION & MAINTENANCE

Inspection & Maintenance

To assure that the evaporative humidifier system provides optimum service life and performance, a periodic inspection of the units should be conducted. The purpose of these inspections is to determine the level of maintenance required. These inspections should be performed on a weekly basis and needed maintenance items reported to maintenance supervisors so that repair work can be scheduled.

A check list should be developed for the personnel assigned to perform the inspection. The items to be inspected are as follows:

Water Flow Rates

- Establish flow rates for your units and record readings during each inspection. Adjust the rates as needed.
- Flow rates should be 1.5 gpm per square foot of top surface area for recirculating water systems and no less then 1.0 gpm per square foot for once-through water.
- Less than recommended flow rates will promote scaling of media surfaces and reduce the humidification efficiency of the units.
- Check flowmeters on each distribution header. Adjust the flow and clean the sight glasses on a regular basis. If there are no flow meters on the system, one should be installed on each header.
- Check the operation of the flow control valves on each distribution header and clean or replace as needed. Flow Control Valves should be installed on each header to assure proper flow rates, regardless of whether or not the other headers are in operation.

Water Distribution

- Assure that there is even distribution of water across the entire face of the humidifier system.
- Check for dry areas and leaks.
- If there are dry areas, open the header flush valve to clear pipe and clean header pipe holes.
- If there is water leaking out of the header section, check fit of facia and condition of facia gasketing. Perform any needed maintenance.
- If the problem continues to exist, design new header pipes and splash covers.

Media Condition

- Check the condition of the media.
- Is the media scaled?
- Is the media soft and/or collapsing?
- Is there evidence of bacteria growth?
- Does any media need replacement?
- Is media installed in the correct direction (45° corrugation pointing up into the air stream)?
- Is media laterally compressed adequately? If loose, tighten the side compression plate.
- Is media intermediate support adequate?
- Is media being dried out on a regular basis?
- Check and correct water flow rate, bleed-off, scale index and conductivity.

Water Collection Sumps

- Check the condition of the water collection sump system.
- Is there evidence of corrosion?
- Does the system need cleaning?
- Is there evidence of biological growth?
- Is the media sitting in water?
- Is the drain and bleed off line clear?
- Adjust and correct problem areas.

Solenoids

- Check all solenoids.
- Are all solenoids valves energizing?
- When energized, is there flow to the header?
- Is there flow to the header when not energized?
- Repair or replace as necessary.

Humidity Sensor

- Check humidity sensors and controls.
- Is booth humidity correlating with controller read-out?
- When was the humidity sensor last calibrated?
- Adjust and/or replace as necessary.

Recirculating System

- Is blowdown control maintaining water at the recommended scaling index?
- Is an adequate flush cycle being performed weekly? (1-2 hours with fans off)
- Is media permitted to dry completely on a regular basis - once per week?
- If biocide is being added is it being added on a regular basis?
- Adjust system as required.
- Refer to Humidifier Water Treatment Bulletin to obtain recommended scaling indices and media drying time.

For more information Contact Munters Corporation, HumiCool Division 1-800-446-6868 or 239-936-1555

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Munters

ENGINEERING BULLETIN
EB-HWT-0304

HUMIDIFIER WATER TREATMENT

Most chemical treatment programs are designed to prevent precipitation of scale forming minerals in heat exchangers. The cooling of the water by evaporation/convection occurs at the cooling tower, not the heat exchanger. The fill in the cooling towers stay clean by flushing it with a sufficient flow of water to prevent deposits from developing. If you experience poorly wetted areas then deposition will occur in the tower.

With evaporative coolers, the evaporation occurs on the surface of the media. When mineral concentrations in the water are too high and/or insufficient water is in contact with media surface, mineral salts concentrate and deposit on the media face. Chemical treatment by use of scale inhibitors will have little or no positive effect in evaporative cooler applications. In essence, the scale inhibitors will become part of the scale deposit. Thus, conventional water treatment methods do not apply to evaporative coolers.

Similarly, the pretreatment of water using a water softener which converts the calcium and magnesium bicarbonates to sodium bicarbonates will also have little or no positive effect. Although the sodium bicarbonate deposits are softer and easily removed by washing down the media, they present the further problem of blowing off the media into the airstream when dry.

The removal of most of the mineral salts through demineralization, reverse osmosis, etc., will eliminate the scaling problem. However, these types of treatment methods requires major initial investments and high operating costs. Water treated in this manner is also very corrosive to common metals and may deteriorate the media by leaching out and degrading the stiffening agents and glue.

Water Flow Rates and Distribution

Using recommended water flow rates in conjunction with even water distribution across the entire media bank is the accepted, and most successful, means of minimizing or eliminating scale deposition. The constant washing of the face of the media with an acceptable volume of water will continuously clean the media surface.

The water should be supplied to each media bank distribution header at a rate of 1.5 gpm per square foot of media top surface area.

The evaporation rate changes little when more water is used. If less water is applied, two things occur, both of which have a negative affect. First, with lower water rates, concentrated mineral salts will accumulate faster due to there being less water volume to flush the face of the media. Secondly, there maybe insufficient water on the face of the media to provide the cleansing action that is desired and required.

Scaling Index

The water treatment industry uses several indices to determine the solubility of various minerals in water. These indices are referred to as scaling indices and take into consideration the following constituents; total dissolved solids, temperature, calcium hardness, total alkalinity and pH. Each constituent is used in a formula to determine if the water is scale forming or scale dissolving, as well as the severity of the reaction. For evaporative cooling and humidification, it is desirable to maintain a slightly scale dissolving index so that the recirculating water has the ability to dissolve mineral deposits. However, the water should not be so aggressive (scale dissolving) that it degrades the media.

Recommended Values for Common Indices for Maintaining Recirculating Water Systems

Langlier Saturation Index (LSI)	0.5 ± 0.25
Ryznar Stability Index (RSI)	6.0 ± 0.5
Puckorius Stability Index (PSI)	6.5 ± 0.5

Maintenance levels are best controlled through bleed-off of system water at a predetermined rate. The preferred method for controling bleed off is through the use of a conductivity controller.

Once-Through Water

There are many humidification systems that use water on a once-through basis, reclaiming some of this water for other uses or dumping it to the sewer. Many of the surface and well waters used in once-through and recirculation systems are

aggressive (scale dissolving) and will degrade the media. In these cases the best solution is to decrease the water flow rate to 1.0 gpm per square foot of top surface area. This will help extend media life and reduce once-through water costs.

The best guide in choosing the proper flow rate (1.0 vs 1.5 gpm/sqft) is to again use the scaling indices. Use the following table to help select the flow rate for a once-through system:

Water Flow Rates for Once Through Systems Based on Common Stability Indices

Index	1 gpm/sq ft	1.5 gpm/sq ft
Langlier Saturation Index (LSI)	< 0	0.5 ± 0.25
Ryznor Stability Index (RSI)	> 7.0	6.0 ± 0.5
Puckorius Stability Index (PSI)	> 7.5	6.5 ± 0.5

Biological Control

Uncontrolled growth of organic matter can result in plugged media, metal deterioration, media degradation, and undesirable odors downstream in the air supply.

There are many types of proprietary and commodity biological control agents on the market which are used in evaporative coolers/humidifiers.

The best control approach, however, is to allow the media pads to dry out completely on a weekly basis. This requires running the fans for a suitable period of time to permit complete drying of the pads. At an incoming ambient air temperature of 70°F, the following drying times should be used as a guide.

Drying Times for Various Media Depths

Media Depth	Drying Time
4 inches	30 minutes
6 inches	1 hour
8 inches	1 1/2 hours
12 inches	2 hours
18 inches	3 hours
24 inches	4 hours

Biocides

The commonly used proprietary non-oxidizing biocides that are sold by water treatment companies will have no adverse affects on the media when applied at EPA recommended dosages. EPA recommended dosage levels can be found on the drum label or furnished by the vendor.

Oxidizing biocides, such as chlorine and bromine can have a very detrimental effect on the media and should be not be used on a regular basis.

Corrosion Control

The best approach to corrosion control in a humidification system is to fabricate the retaining system from non-corrosive metals or plastics.

If a corrosion inhibition program is required, as with large central recirculating systems, consult a reputable local water treatment company for their recommendations for your system. In doing so, be sure they provide an analytical monitoring program (such as corrosion coupons) to assure that the corrosion control of ferrous and non-ferrous metals is effective.

In all cases avoid programs which include phosphates. Phosphates will increase scale deposition and provide a nutrient for algae and bacteria.

The data and suggestions contained herein are based on information Munters believes to be reliable. They are offered in good faith, but without guarantee, as conditions and methods of use are beyond our control. We recommend that the prospective user determine the suitability of our media and suggestions before adopting them on a commercial scale.

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INSPECTION OF _____ EVAPORATIVE COOLER SYSTEM																								
DATE	BY	FLOW RATE			BLEED-OFF RATE			H2O DISTRIB.			MEDIA COND.			FLOAT OPERATED FILL VALVE TEST			OVERFLOW SAFETY MEASURES TEST			SUMP COND.			TEMP. CONTROL FUNCTION	COMMENTS
		G	F	P	G	F	P	G	F	P	G	F	P	G	F	P	G	F	P	G	F	P		

G=GOOD F=FAIR P=POOR

ABS ROBUSTA LIGHT DRAINAGE PUMP 60 Hz

The next generation of submersible pumps for clear and surface water with built-in checkvalve for house, yard and garden. Unique float switch system that offers automatic and manual operation that is rust proof and clog proof, ½" solids capacity

Applications

The ABS ROBUSTA has been designed for pumping clear and wastewater from house, garden or yard, and is supplied with built-in level control and checkvalve. The pump and motor section form a pressure-tight encapsulated unit, with motor housing constructed from corrosion resistant material. The outer jacket and impeller are made of durable plastics. The unique hand/auto switch makes the pump suitable for manual or automatic operation.

Construction

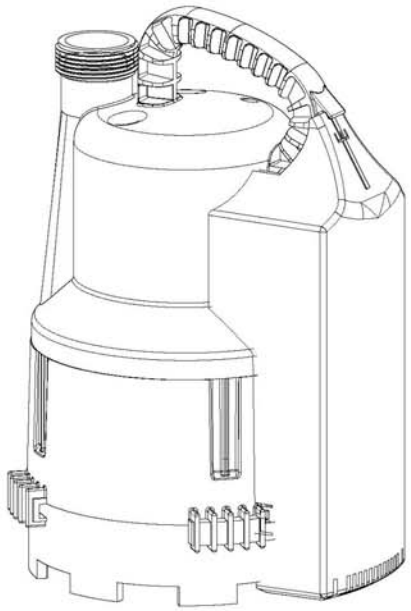
- Discharge outlet 1½" with built-in checkvalve.
- Connection chamber with cover and watertight cable inlet and strain relief.
- Outer jacket and other housing parts made of corrosion resistant synthetic material. Motor housing is made of coated aluminium.
- Motor is dynamically balanced with temperature monitor in the stator, which switches off the pump in the case of overheating and switches on automatically after cooling down.
- Shaft is made of stainless steel.
- The sealing on the motor side is by means of special lip seals supported by lubricated ball bearings.
- The medium being pumped flows around the motor housing for optimum heat dissipation.
- The medium temperature is 40° C (104 F); intermittent usage to 60° C (140 F) (max. 5 min).
- The TS version has a built-in automatic level control, with easily removable float cover for cleaning purposes.
- Separate switch for continuous operation in transportable applications.
- The special bayonet clamping allows the screen to be removed by hand in the event an impeller inspection is necessary.

Materials

Pump casing	Polypropylene
Motor shaft	1.4021 (AISI 420)
Impeller	Polyamide
Seals	Neoprene
Cable	Neoprene

- ☐ Two position manual/automatic switch
- ☐ Rust proof polypropylene construction
- ☐ Fits into 8" diameter opening
- ☐ 1½" female discharge
- ☐ Check-valve included
- ☐ Environmentally safe oil-free motor
- ☐ Air filled capacitor start motor
- ☐ Clog proof impeller design
- ☐ ½" solids handling capability
- ☐ Removeable bottom screen for ⅛" pumps down
- ☐ UL and CSA listed

ABS light drainage pump ROBUSTA



15970227GB (03/2006)

US

Installation and operating instructions

www.absgroup.com

Starting and operating instructions

US

ABS light drainage pump ROBUSTA

100 200 300

Application

Compact submersible drainage pumps from ABS are used where large quantities of clear, rain or dirty water must be pumped quickly and reliably.

Permanent installations of pumps include basement sumps for water removal. They are suitable for pumping washing effluent, for the drainage of buildings and for pumping rainwater out of lower level rooms or underpasses.

They are used as portable pumps to fill or empty containers of every type, for use in drainage pits, to maintain dry conditions in ditches and to pump out flooded cellars.

Handling

During transport the submersible pump should not be dropped or thrown.

CAUTION! Always lift the pump by the lifting handle - never by the power cable.

Installation and Operation

The pumps are supplied ready for operation

WARNING: Pumps must be installed in accordance with governing national and local electrical codes.

For Automatic Operation

ROBUSTA WTS: Install discharge hose or pipe to pump discharge. Position the pump in the sump, switch to the automatic position by pushing the switch down. The float switch will now start the pump when the water level reaches about 6", pump shuts off at about 2". Be sure to test automatic operation after installing to make sure the pump is operating properly

For Manual Operation

ROBUSTA WTS: Install discharge hose or pipe to pump discharge, place the pump in the water to be pumped, switch to the manual "HAND" position by pushing the switch up. Switch the pump off when the water reaches approximately 2", by pushing the switch down into the automatic position or by unplugging the power cord.

NOTE ***In portable applications, when a sump is pumped down below 1" of water, the pump requires approximately 30 seconds to purge air from the discharge when restarting.***

Maintenance

The pump has permanently lubricated bearings and an overload protection device to ensure maximum pump serviceability. Regular inspection and maintenance are, however, recommended in order to ensure long service life.

Always disconnect pump from electrical source before performing any type of maintenance. The pump should be cleaned from time to time (depending on degree of dirt present) and the inlet screen should be cleaned and rinsed in clean water:-

ROBUSTA 100/200 WTS only: The volute\screen can be removed by turning it clockwise. Then the impeller area may also be cleaned. (Due care should be taken not to dislodge the motor). (Please ensure O-Ring is in correct position when re-fitting Volute/Screen.)

ROBUSTA 300 WTS only: The screen can be removed by turning it clockwise. The lower volute should then be removed and both cleaned and rinsed in clean water. Then the impeller area may also be cleaned.
Never open the motor section of the pump, as dismantling could damage the seals.
(Please ensure O-Ring is in correct position when re-fitting Volute and Screen.)

WARNING: Risk of electrical shock, this pump is supplied with a grounding conductor and grounding-type attachment plug. To reduce the risk of electrical shock, be certain that it is connected only to a properly grounded, grounding receptacle, motor is thermally protected. To reduce risk of electrical shock, pull plug before servicing this pump.
This pump has not been investigated for use in swimming pool areas.

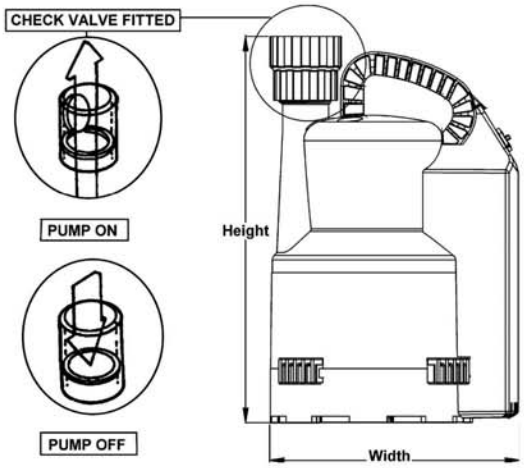
Warranty

ABS Pumps Inc. warrants the ROBUSTA pump to be free from defects in workmanship and material for a period of twelve (12) months from date of sale to end customer. Pumps used in transportable (i.e. contractor / dewatering) applications carry a six (6) month warranty from the date of sale to end customer. This warranty does not cover the pumping of chemically or abrasively polluted water. ABS Pumps Inc. shall not be liable for any special, indirect or consequential damages of any kind. Defective equipment will be repaired or replaced. Returns must have prior written authorization from the company and be shipped prepaid.

NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE WILL APPLY.

Technical Data

Model	ROBUSTA 100 WTS	ROBUSTA 200 WTS	ROBUSTA 300 WTS
Current	Single Phase	Single Phase	Single Phase
HP	1/4	1/3	1/2
RPM	3450	3450	3450
Voltage	115	115	115
Amps	See nameplate	See nameplate	See nameplate
Discharge	1¼" /1½"	1¼" /1½"	1¼" /1½"
Height	12" (308 mm)	12" (308 mm)	12.6" (320 mm)
Width	7.7" (196 mm)	7.7" (196 mm)	7.7" (196 mm)
Weight	6.6 lb (3.0 kg)	7.3 lb (3.3 kg)	8 lb (3.6 kg)
Cable	10 ft. U.L listed	10 ft. U.L listed	10 ft. U.L listed



Little GIANT®

CP SERIES

Features

- Thermal overload protection
- Heavy-duty concentric fan-cooled motor with oversized sleeve bearings and moisture proof windings
- For residential and commercial cooler applications
- Corrosion resistant one-piece steel shaft
- Snap-off volute plate for easy cleaning
- Flame retardant housing
- Universal mounting configurations
- 90° barbed elbow with bleed-off port
- 4' power cord with three-prong plug
- Low pump down and recovery levels
- Mesh screen
- Liquid Temp. up to — 120° F

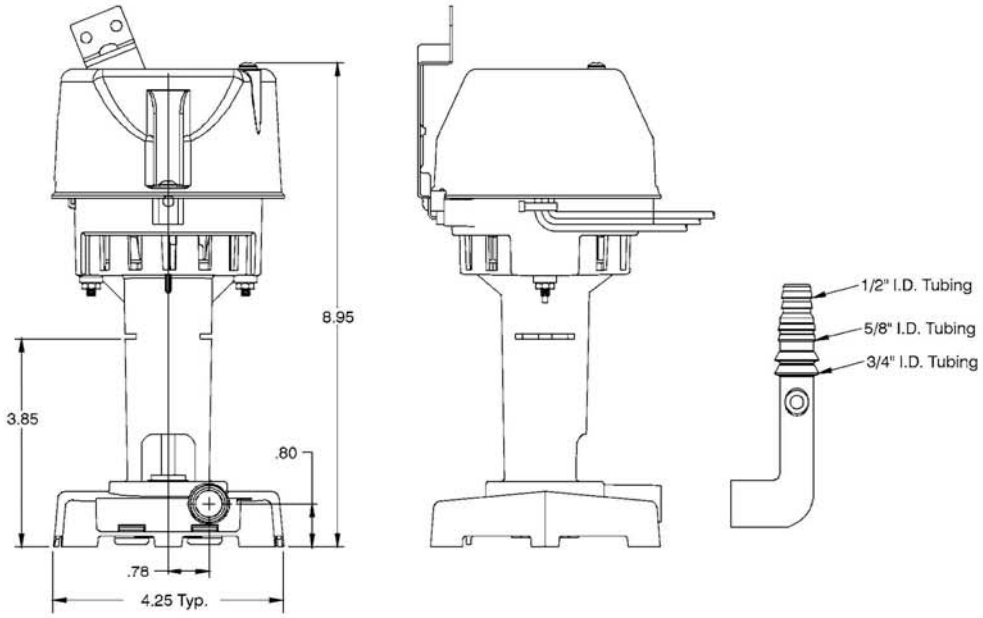
Construction

- Motor — Heavy duty fan cooled
- Housing — Flame resistant engineered thermal plastic
- Cover — Flame resistant engineered thermal plastic
- Volute — Flame resistant engineered thermal plastic
- Impeller — Polyester
- Mounting Bracket — Galvanized steel

CP1 Series — 5,000–7,000 CFM
CP2 Series — 7,500–15,000 CFM
CP3 Series — 15,000–21,000 CFM

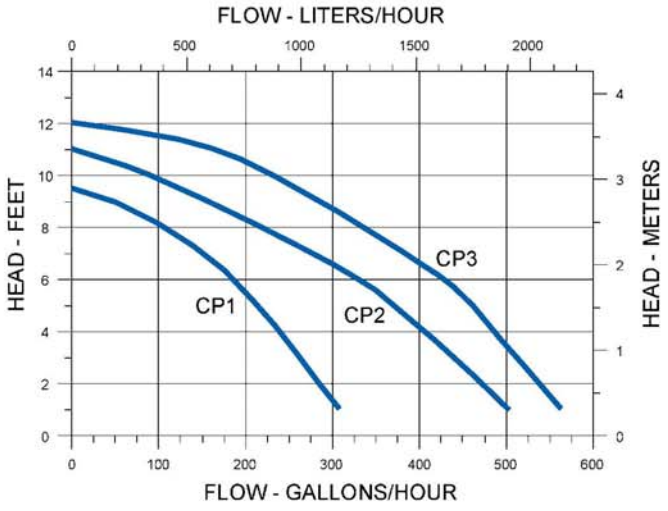
Little Giant Pump Company's line of non-submersible Evaporative Cooler Pumps is designed to give years of trouble-free service in recirculating applications as replacement units for original equipment. For use in evaporative coolers, displays, laboratories, water transfer, and other applications.

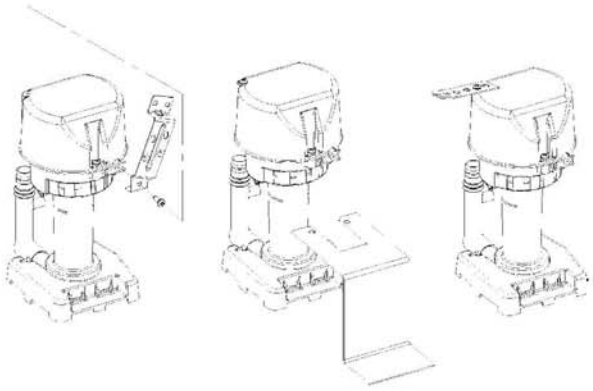
CP SERIES



Specifications

Model No.	Item No.	Discharge	Listings	HP	Volts	Hertz	Amps	Watts	Performance (GPH @ Head) 1'	3'	5'	10'	Shut Off Feet	PSI	Pwr. Cord (ft.)	Weight (lbs.)
CP1-115	540005	1/2", 5/8", 3/4"	UR	1/70	115/127	60	.8	70	307	265	213	—	9.5	4.1	4	2.5
CP1-230	540015	1/2", 5/8", 3/4"	UR	1/70	230	50/60	.4	70	307	265	213	—	9.5	4.1	4	2.5
CP2-115	541005	5/8", 3/4"	UR	1/50	115	60	1.0	80	502	440	371	89	11	4.8	4	3.0
CP2-230	541015	5/8", 3/4"	UR	1/50	230	50/60	.5	80	502	440	371	89	11	4.8	4	3.0
CP3-115	542005	5/8", 3/4"	UR	1/30	115	60	1.1	90	563	512	460	231	12	5.2	4	3.5
CP3-230	542015	5/8", 3/4"	UR	1/30	230	50/60	.56	90	563	512	460	231	12	5.2	4	3.5





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Form 995506 — 09/2002

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EVAPORATIVE COOLER PUMPS
POMPES À REFROIDISSEUR À ÉVAPORATION
BOMBAS PARA EL ENFRIADOR EVAPORATIVO

GB INTRODUCTION

Little Giant pumps are carefully inspected, tested and packaged to insure safe operation. When you receive your pump, examine it carefully to determine that there are no broken or damaged parts that may have occurred in shipment. If damage has occurred, make notation and notify the firm from which you purchased the pump. They will assist you in the replacement or repair of the pump.

READ INSTRUCTIONS CAREFULLY BEFORE ATTEMPTING TO INSTALL, OPERATE OR SERVICE THE LITTLE GIANT PUMP. KNOW THE PUMP APPLICATIONS, LIMITATIONS AND POTENTIAL HAZARDS. PROTECT YOURSELF AND OTHERS BY OBSERVING ALL SAFETY INFORMATION. FAILURE TO COMPLY WITH INSTRUCTIONS COULD RESULT IN PERSONAL INJURY AND/OR PROPERTY DAMAGE! RETAIN INSTRUCTIONS FOR FUTURE REFERENCE.

SAFETY GUIDELINES

⚠WARNING⚠

1. DO NOT USE TO PUMP FLAMMABLE OR EXPLOSIVE FLUIDS SUCH AS GASOLINE, FUEL OIL, KEROSENE, ETC. DO NOT USE IN EXPLOSIVE ATMOSPHERES. PUMP SHOULD ONLY BE USED WITH LIQUIDS COMPATIBLE WITH PUMP COMPONENT MATERIALS.
2. DO NOT HANDLE PUMP WITH WET HANDS OR WHEN STANDING ON A WET OR DAMP SURFACE, OR IN WATER.
3. DO NOT PICK UP THE PUMP BY THE POWER CORD.
4. IF THE PUMP IS SUPPLIED WITH A GROUNDING CONDUCTOR AND/OR GROUNDING TYPE ATTACHMENT PLUG, TO REDUCE THE RISK OF ELECTRIC SHOCK, BE CERTAIN THAT IT IS CONNECTED TO A PROPERLY GROUNDED GROUNDING TYPE RECEPTACLE.
5. IF THE PUMP IS SUPPLIED WITH STRIPPED LEAD WIRES, BE SURE THAT THE LEAD WIRES ARE CONNECTED TO THE RATED POWER SOURCE CORRECTLY.
6. IN ANY INSTALLATIONS WHERE PROPERTY DAMAGE AND/OR PERSONAL INJURY MIGHT RESULT FROM AN INOPERATIVE OR LEAKING PUMP DUE TO POWER OUTAGES, DISCHARGE LINE BLOCKAGE, OR ANY OTHER REASON, A BACKUP SYSTEM(S) AND/OR ALARM SHOULD BE USED.

ELECTRICAL CONNECTIONS

⚠WARNING⚠

1. Check the pump label for proper voltage required. Do not connect to voltage other than that shown.
2. If pump is supplied with a 3-prong electrical plug, the third prong is to ground the pump to prevent possible electrical shock hazard. DO NOT REMOVE the third prong from the cord. If the plug is cut or the cord is shortened, then this action will void the warranty.

OPERATION

1. This is NOT a submersible pump. DO NOT allow water or water spray to enter motor housing. Water level should not exceed 3".
2. Pump should be positioned as far from cooler pads or water source as possible to prevent water damage to pump motor.
3. Ensure that pump is sized to match the CFM air flow of the cooler, per below chart:

MODEL	CFM
CP1	5,000–7,500
CP2	7,500–15,000
CP3	15,000–21,000

4. The cooler pump is designed for use with many existing evaporative cooling units. If the supplied standard mounting bracket configurations do not fit the application in the evaporative cooler unit, a piece of metal strap can be attached by removing the single screw located on the top of the cover. The pump must be attached by some means to prevent the pump from falling over and allowing water to enter the motor housing. Observe method of mounting and install replacement in same manner as original pump.
5. Depending upon the pump model, the pump is equipped with an elbow designed for use with 1/2", 5/8", or 3/4" ID tubing or simply 5/8" or 3/4" ID tubing. The elbow incorporates a bleed-off port which is designed to allow a small amount of water to be pumped out of the cooler basin which helps reduce scale build up. The bleed-off port is designed to fit 1/4" OD or 3/8" ID tubing. The pump is shipped with the bleed-off port plugged for applications not requiring this feature.
6. Use a screen or strainer around the pump base to prevent particles or debris from clogging the impeller or discharge line.
7. Route the power supply cord of the pump in same manner as was done in the original installation.
8. The following items are offered as replacement:

DESCRIPTION	PART NUMBER
Volute Plate	140345
Volute O-Ring	942030
Elbow (CP1 Models)	140341
Elbow (CP2 & CP3 Models)	140346

SERVICE INSTRUCTIONS

⚠WARNING⚠

MAKE CERTAIN THAT THE UNIT IS DISCONNECTED FROM THE POWER SOURCE BEFORE ATTEMPTING TO SERVICE OR REMOVE ANY COMPONENT!

1. This unit is permanently lubricated. Oiling is not required.
2. Periodically remove the bottom plate which is pressed onto the pump base. Lightly clean any corrosion or debris which may clog the impeller or pump cavity.
3. Turn the impeller by hand to make sure it turns freely. Set pump down so you are not touching pump and impeller is not touching anything. Plug the unit into GFCI circuit for 10 seconds to see if the impeller turns; a) If it is rotating and GFCI did not trip, un-plug unit and install parts in reverse order in which they were removed. b) If it does not rotate, if pump is tripping circuit breakers, or not operating properly after cleaning, return to Little Giant or it's authorized service center. DO NOT attempt repairs yourself.
4. Be certain power cord is in good condition and contains no nicks or cuts.

F INTRODUCTION

Les pompes Little Giant sont soigneusement emballées et inspectées ; elles ont également subi des essais afin d'assurer la sécurité de fonctionnement. À la réception de votre pompe, la vérifier attentivement pour déterminer si des pièces ont été endommagées lors du transport. Si c'est le cas, prendre note de tout dommage survenu et aviser l'entreprise qui vous l'a vendue. Cette entreprise vous assistera pour la réparation ou le remplacement de la pompe.

LIRE ATTENTIVEMENT LES DIRECTIVES AVANT DE PROCÉDER À L'INSTALLATION, À L'UTILISATION OU À L'ENTRETIEN DE LA POMPE LITTLE GIANT. SE FAMILIARISER AVEC LES APPLICATIONS, LES LIMITES ET LES RISQUES POTENTIELS DE LA POMPE. ASSURER SA PROPRE PROTECTION ET CELLE DES AUTRES EN SUIVANT TOUTES LES RÈGLES DE SÉCURITÉ. LE NON-RESPECT DES DIRECTIVES PEUT ENTRAÎNER DES BLESSURES ET/OU DES DOMMAGES MATÉRIELS ! CONSERVER CES DIRECTIVES AFIN DE POUVOIR LES CONSULTER PLUS TARD.

DIRECTIVES DE SECURITE

⚠AVERTISSEMENT⚠

1. NE PAS UTILISER LA POMPE POUR POMPER DES LIQUIDES INFLAMMABLES OU EXPLOSIFS COMME DE L'ESSENCE, DU MAZOUT, DU KÉROSÈNE, ETC. NE PAS UTILISER DANS UNE ATMOSPHÈRE EXPLOSIVE. POMPER SEULEMENT DES LIQUIDES COMPATIBLES AVEC LES MATÉRIAUX DE LA POMPE.
2. NE PAS MANIPULER LA POMPE AVEC LES MAINS MOUILLÉES OU LORSQUE VOUS VOUS TROUVEZ DANS L'EAU OU SUR UNE SURFACE HUMIDE OU DÉTREMPÉE.
3. NE PAS SAISIR LA POMPE PAR LE CORDON D'ALIMENTATION.
4. SI LA POMPE EST FOURNIE AVEC UN CONDUCTEUR DE MISE À LA TERRE ET/OU UNE PRISE DE TYPE MISE À LA TERRE VISANT À RÉDUIRE LE RISQUE DE CHOC ÉLECTRIQUE, S' ASSURER QU'ELLE EST BRANCHÉE CORRECTEMENT À UNE PRISE AVEC MISE À LA TERRE.
5. SI LA POMPE EST FOURNIE AVEC DES FILS DE CONNEXION DÉNUDÉS, S'ASSURER QUE CES FILS SONT CONNECTÉS CORRECTEMENT À LA SOURCE D'ALIMENTATION NOMINALE.
6. POUR TOUTES LES INSTALLATIONS OÙ DES DOMMAGES MATÉRIELS ET/OU DES BLESSURES POURRAIENT SURVENIR SI LA POMPE DEVENAIT INOPÉRANTE OU PRÉSENTAIT DES FUITES LORS D'UNE PANNE D'ÉLECTRICITÉ, D'UNE OBSTRUCTION DES TUYAUX DE DÉCHARGE OU POUR TOUTE AUTRE RAISON, UTILISER UN OU DES SYSTÈMES AUXILIAIRES ET/OU UN SYSTÈME D'ALARME.

CONNEXIONS ELECTRIQUES

⚠AVERTISSEMENT⚠

1. Vérifier l'étiquette de la pompe pour connaître la tension appropriée. Ne pas connecter à une tension autre que celle indiquée sur l'étiquette.
2. Si la pompe est fournie avec une fiche électrique à trois broches, la troisième broche sert pour la mise à la terre de la pompe et prévient les risques de décharge électrique. NE PAS ENLEVER la troisième broche de la fiche. Si la fiche est coupée ou si le cordon est raccourci, la garantie est annulée.

FONCTIONNEMENT

1. Cette pompe n'est PAS submersible. NE PAS laisser d'eau ou d'eau pulvérisée pénétrer dans le carter du moteur. Le niveau d'eau ne doit pas dépasser 7,6 cm (3 po).
2. La pompe doit être positionnée le plus loin possible des coussinets de refroidissement ou de la source d'eau pour prévenir les dommages que l'eau peut causer au moteur de la pompe.
3. S'assurer que la taille de la pompe correspond au débit d'air par minute du refroidisseur, selon le tableau :

MODÈLE	M³/MIN (PI³/MIN)
CP1	142 à 212 m³ (5 000 à 7 500 pi³)
CP2	212 à 425 m³ (7 500 à 15 000 pi³)
CP3	425 à 595 m³ (15 000 à 21 000 pi³)

4. La pompe à refroidissement est conçue pour de nombreux systèmes de refroidissement par évaporation d'eau déjà en place. Si les configurations du support de fixation standard fourni ne conviennent pas au système de refroidissement par évaporation d'eau, une bande métallique peut être ajoutée en enlevant la vis unique située sur le dessus du couvercle. La pompe doit être fixée de manière à l'empêcher de tomber et de permettre à l'eau de s'infiltrer dans le carter du moteur. Respecter la méthode de montage et installer la pompe de remplacement comme pour la pompe d'origine.
5. Selon le modèle de la pompe, cette dernière est équipée d'un coude conçu pour un usage avec un tuyau de 12,7 mm, 15,9 mm ou 19,1 mm (1/2 po, 5/8 po ou 3/4 po) de diamètre intérieur ou un tuyau de 15,9 mm ou 19,1 mm (5/8 po ou 3/4 po) de diamètre intérieur. Le coude comporte un orifice de purge conçu pour permettre l'évacuation d'une petite quantité d'eau hors du bassin de refroidissement, afin de réduire l'accumulation de tartre. L'orifice de purge est conçu pour convenir aux tuyaux d'un diamètre extérieur de 6,35 mm (1/4 po) ou d'un diamètre intérieur de 9,52 mm (3/8 po). Au moment de l'expédition, l'orifice de purge de la pompe est bouché pour les applications qui ne requièrent pas cette fonction.
6. Utiliser un écran ou une grille autour de la base de la pompe pour empêcher les particules ou les débris d'engorger la turbine ou la ligne de décharge.
7. Acheminer le cordon d'alimentation de la pompe comme pour l'installation d'origine.
8. Articles de rechange :

DESCRIPTION	NUMÉRO DE PIÈCE
Plaque de volute	140345
Joint torique de volute	942030
Coude (modèles CP1)	140341
Coude (modèles CP2 et CP3)	140346

DIRECTIVES D'ENTRETIEN

⚠AVERTISSEMENT⚠

S'ASSURER QUE L'APPAREIL EST DÉBRANCHÉ DE SA SOURCE D'ALIMENTATION AVANT D'EFFECTUER L'ENTRETIEN OU D'ENLEVER UNE COMPOSANTE !

1. Cet appareil est lubrifié en permanence. Il ne requiert aucun ajout d'huile.
2. Retirer périodiquement la plaque inférieure qui s'appuie sur la base de la pompe. Nettoyer délicatement toute corrosion ou tout débris susceptible d'engorger la turbine ou la cavité de la pompe.
3. Faire tourner la turbine à la main pour s'assurer qu'elle tourne librement. Poser la pompe pour éviter tout contact et pour que la turbine n'entre en contact avec aucun élément. Brancher l'appareil dans un circuit de disjoncteur de fuite à la terre pendant dix secondes pour vérifier que la turbine tourne ; a) Si elle tourne et que le disjoncteur ne s'est pas déclenché, débrancher l'appareil et installer les pièces dans l'ordre inverse de leur dépose. b) Si la turbine ne tourne pas, si la pompe déclenche les disjoncteurs ou ne fonctionne pas correctement après le nettoyage, la retourner à Little Giant ou à un de ses centres de service autorisé. NE PAS tenter d'effectuer les réparations soi-même.
4. S'assurer que le cordon d'alimentation est en bon état et n'est pas entaillé ou coupé.

E INTRODUCCION

Adjunta a su bomba Little Giant, se encuentra una hoja de instrucciones que le proporciona la informacion necesaria para poseer y hacer funcionar sin peligro su bomba Little Giant. La hoja de instrucciones abarca principalmente los modelos corrientes de cada serie de bombas. El formulario es aplicable a los demas modelos de la serie, que no aparecen enunciados por número de catálogo en la seccion de la lista de piezas de repuesto de la hoja de instrucciones. Si el número de catálogo de su bomba no aparece en la seccion de la lista de piezas de repuesto, debe procederse con precaución al ordenar piezas de repuesto. Al ordenar piezas de repuesto, indique siempre el número de catálogo de su bomba.

Los materiales y la mano de obra de la unidad Little Giant que usted ha adquirido, son óptimos. Se ha fabricado para servirle sin tropiezos durante largo tiempo. Las bombas Little Giant se embalan, inspeccionan y prueban cuidadosamente, para garantizar un funcionamiento y una entrega sin peligro. Cuando reciba su bomba, examinela cuidadosamente, para veriticar que durante el transporte no se haya roto ni averiado ninguna pieza. Si encuentra algun daño, tome nota de él, e informe a la firma de la cual adquirió la bomba; ella le ayudará a cambiarla o repararla, si es necesario.

Esta hoja de instrucciones le proporcionará la información requerida para que pueda ser propietario de y poner en funcionamiento con seguridad las bombas Little Giant de Serie PE-1. La bomba que ha comprado es un bomba sumergible encapsulada con epoxia con una carcasa externa construida de un termoplástico duradero. La caja está rellena de una epoxia especial de transferencia de calor.

LEA CUIDADOSAMENTE LAS INSTRUCCIONES, ANTES DE INTENTAR INSTALAR, HACER FUNCIONAR O REPARAR LA BOMBA LITTLE GIANT. CONOZCA LOS USOS, LIMITACIONES Y PELIGROS POTENCIALES DE LA BOMBA. PROTEJASE Y PROTEJA A LOS DEMAS, OBSERVANDO TODAS LAS NORMAS DE SEGURIDAD. SI NO SE OBEDECEN LAS INSTRUCCIONES, PUEDEN PRODUCIRSE LESIONES, DAÑOS MATERIALES O AMBOS. CONSERVE LAS INSTRUCCIONES PARA CONSULTARLAS EN EL FUTURO.

NORMAS DE SEGURIDAD

¡ADVERTENCIA¡

1. NO UTILICE EL EQUIPO PARA BOMBEAR LÍQUIDOS INFLAMABLES O EXPLOSIVOS COMO GASOLINA, ACEITE COMBUSTIBLE, QUEROSENO U OTROS. NO LO UTILICE EN AMBIENTES EXPLOSIVOS. LA BOMBA SÓLO SE DEBE UTILIZAR CON LÍQUIDOS COMPATIBLES CON LOS MATERIALES DE FABRICACIÓN DE LA BOMBA.
2. NO MANEJE LA BOMBA CON LAS MANOS MOJADAS O CUANDO SE ENCUENTRE PARADO SOBRE EL SUELO MOJADO, HÚMEDO O CUBIERTO CON AGUA.
3. NO LEVANTE LA BOMBA POR EL CABLE DE ENERGÍA.
4. SI LA BOMBA SE SUMINISTRA CON UN CONDUCTOR DE CONEXIÓN A TIERRA Y/O ENCHUFE DE CONEXIÓN A TIERRA, PARA REDUCIR EL RIESGO DE CHOQUE ELÉCTRICO, ASEGÚRESE DE QUE ESTÉ DEBIDAMENTE CONECTADO A UN RECEPTÁCULO PARA CONEXIÓN A TIERRA DEBIDAMENTE CONECTADO A TIERRA.
5. SI LA BOMBA SE SUMINISTRA CON CABLES SIN FORRO, ASEGÚRESE DE QUE ESTÉN CONECTADOS CORRECTAMENTE A LA FUENTE DE ENERGÍA CON LA CAPACIDAD APROPIADA.
6. SE DEBE UTILIZAR UNO O VARIOS SISTEMAS DE RESPALDO Y/O ALARMA EN CUALQUIER INSTALACIÓN DONDE SE PUEDAN PRODUCIR DAÑOS A LA PROPIEDAD Y/O LESIONES PERSONALES COMO RESULTADO DE UNA BOMBA QUE NO FUNCIONA O QUE TIENE FUGAS DEBIDO A UN CORTE DE ENERGÍA, BLOQUEO DE LA LÍNEA DE DESCARGA O CUALQUIER OTRA RAZÓN.

CONEXIONES ELECTRICAS

¡ADVERTENCIA¡

1. Verifique el voltaje apropiado en la etiqueta de la bomba. No la conecte a un voltaje distinto al indicado.
2. Si bomba se suministra con un cable de electricidad que contiene tres clavijas, la tercera clavija es para conectar la bomba a tierra para evitar la posibilidad del riesgo de choque eléctrico. NO ELIMINE la tercera clavija del cable. Si se corta la clavija o se acorta el cable, la garantía quedará anulada.

FUNCIONAMIENTO

1. Esta bomba NO es sumergible. NO permita que el agua o el rocío de agua entre en el alojamiento del motor. El nivel de agua no debe exceder 76,2 mm (3 pulg.).
2. La bomba se debe colocar lo más lejos posible de los paneles del enfriador o fuente de agua para evitar que el agua dañe el motor de la bomba.
3. Asegúrese de que la capacidad de la bomba concuerde con el flujo de aire, en pies cúbicos por minuto, del enfriador, según se indica en la tabla a continuación:

MODELO	PIES CÚBICOS POR MINUTO
CP1	5.000–7.500
CP2	7.500–15.000
CP3	15.000–21.000

4. La bomba para el enfriador está diseñada para usarse con muchas de las unidades de enfriamiento por evaporación existentes. Si las configuraciones de abrazaderas de montaje convencionales que vienen incluidas no sirven para la unidad del enfriador evaporativo que se está usando, se puede quitar el único tornillo ubicado en la parte superior de la tapa para colocar una sección de fleje metálico. La bomba debe fijarse de alguna manera para prevenir que se incline hacia adelante y entre agua al alojamiento del motor. Observe la forma en que está montada e instale la bomba de reemplazo en la misma manera en que estaba la bomba original.
5. Según el modelo, la bomba está equipada con un codo diseñado para utilizarse con tuberías de 12,7, 15,88 ó 19,05 mm (½, 5/8 ó ¾ de pulgada) de diámetro interior o simplemente con tubería de 15,88 ó 19,05 mm (5/8 ó ¾ de pulgada) de diámetro interior. El codo incorpora un puerto de alivio diseñado para bombear una pequeña cantidad de agua fuera de la cubeta de refrigeración, lo que permite reducir la acumulación de costra de óxido. El puerto de alivio está diseñado para ajustarse a un tubo de 6,35 mm (¼ de pulgada) de diámetro exterior o 9,53 mm (3/8 de pulgada) de diámetro interior. La bomba viene de fábrica con el puerto de alivio tapado para las aplicaciones en que no sea necesaria.
6. Utilice una rejilla o colador alrededor de la base de la bomba para evitar que las partículas o los desechos tapen el impulsor o la línea de descarga.
7. Conecte el cable de suministro de energía de la bomba de la misma forma que se hizo en la instalación original.
8. Los siguientes componentes se ofrecen como piezas de recambio:

DESCRIPCIÓN	NÚMERO DE PIEZA
Placa de espiral	140345
Anillo tórico de la espiral	942030
Codo (modelos CP1)	140341
Codo (modelos CP2 y CP3)	140346

INSTRUCCIONES DE SERVICIO

¡ADVERTENCIA¡

¡ASEGÚRESE DE QUE LA UNIDAD ESTÉ DESCONECTADA DEL SUMINISTRO DE ENERGÍA ANTES DE REALIZAR CUALQUIER SERVICIO TÉCNICO O RETIRAR CUALQUIER COMPONENTE!

1. Esta unidad cuenta con lubricación permanente. No requiere aceite.
2. De vez en cuando, retire la placa inferior que está presionada en la base de la bomba. Limpie ligeramente cualquier corrosión o los desperdicios que puedan tapar el impulsor o el orificio de la bomba.
3. Haga girar el impulsor a mano para asegurarse de que gire libremente. Ponga la bomba en el piso para que usted no toque la bomba y el impulsor no haga contacto con nada. Enchufe la unidad en el interruptor de circuito para fallas de conexión a tierra (GFCI, por sus siglas en inglés) por 10 segundos para ver si el impulsor gira; a) Si gira y no se activa el GFCI, desenchufe la unidad e instale las piezas en el orden inverso al que se quitaron. b) Si no gira, si la bomba está activando los interruptores de circuito o no funciona debidamente después de la limpieza, devuélvala a Little Giant o al centro de servicio técnico autorizado. NO intente realizar las reparaciones usted mismo.
4. Asegúrese de que el cable de energía esté en buenas condiciones y que no esté quebrado o cortado.

LIMITED WARRANTY

Your Little Giant product is guaranteed to be in perfect condition when it leaves our Factory. It is warranted against defective materials and workmanship for a period of 12 months (90 day warranty on Models: 1-AA-OM, GKPK-SC, PP-1, PPS-1, PP-12, PPS-12, PP-230 and Cooler King) from date of purchase by the user. No warranty on brush wear in Model 35-OM and impeller or cam in Models PP-1, PP-12, and PP-230.

Any product that should fail for either of the above two reasons and is still within the warranty period will be repaired or replaced at the option of Little Giant as the sole remedy of buyer. For our customers in the CONTINENTAL UNITED STATES: Please return the defective unit, postage paid, to the factory at 301 North MacArthur Blvd., Oklahoma City, OK 73127-6616. All defective product returned under warranty will be fully inspected to determine the cause of failure before warranty is approved.

For our customers located elsewhere; it is not economical, due to duties and freight, to return the pump to the factory for inspection. Please return the defective unit to any authorized distributor or dealer with a brief written explanation of the problem. If there are no apparent signs of customer abuse, unit will be repaired or replaced. If dispute arises over replacement of the pump, the distributor or dealer is to segregate such items and hold for inspection by a representative of Little Giant Pump Company or notify factory with details of the problem for factory disposition and settlement of warranty claim.

DISCLAIMER: THE FOREGOING WARRANTY IS AN EXCLUSIVE WARRANTY IN LIEU OF ANY OTHER EXPRESS WARRANTIES. ANY IMPLIED WARRANTIES (INCLUDING, BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE) TO THE EXTENT EITHER APPLIES TO A PUMP SHALL BE LIMITED IN DURATION TO THE PERIODS OF THE EXPRESS WARRANTIES GIVEN ABOVE.

Warranty will be **VOID** if any of the following conditions are found:

1. Sealed motor housing opened.
2. Product connected to voltage other than indicated on nameplate.
3. Cord cut off to a length less than three feet.
4. Pump allowed to operate dry (fluid supply cut off).
5. Pump used to circulate anything other than fresh water, light oils, or other mild liquids at approximately room temperature.
6. Product abuse by customer.

Any oral statements about the product made by the seller, the manufacturer, the representatives or any other parties, do not constitute warranties, shall not be relied upon by the user and are not part of the contract for sale. Seller's and manufacturer's only obligation, and buyer's only remedy, shall be the replacement and/or repair by the manufacturer of the product as described above. NEITHER SELLER NOR THE MANUFACTURER SHALL BE LIABLE FOR ANY INJURY, LOSS OR DAMAGE, DIRECT, INCIDENTAL OR CONSEQUENTIAL (INCLUDING, BUT NOT LIMITED TO INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR LOST PROFITS, LOST SALES, INJURY TO PERSON OR PROPERTY, OR ANY OTHER INCIDENTAL OR CONSEQUENTIAL LOSS), ARISING OUT OF THE USE OR THE INABILITY TO USE THE PRODUCT AND THE USER AGREES THAT NO OTHER REMEDY SHALL BE AVAILABLE TO IT. Before using, the user shall determine the suitability of the product for the intended use, and user assumes all risk and liability whatsoever in connection therewith.

Some states and countries do not allow limitations on how long an implied warranty lasts or the exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state and country to country.

The National Electric Code (in the USA) and similar codes in other countries require a Ground Fault Circuit Interrupter (GFCI) to be installed in the branch circuit supplying fountain equipment rated above 15 volts. 115 volt GFCI's (with various cord lengths) are in stock, and we recommend each pump be used with a GFCI.

GARANTIE LIMITÉE

La présente garantit que votre pompe Little Giant est en parfaite condition à sa sortie de l'usine. La pompe est garantie contre tout défaut de matériau ou de fabrication pendant une période de 12 mois (90 jours pour les Modèles: 1-AA-OM, GKPK-SC, PP-1, PPS-1, PP-12, PPS-12, PP-230 et Cooler King) à partir de la date d'achat initial. L'usure des balais sur le modèle 35-OM ainsi que les dommages au rotor ou à la came sur les modèles PP-1, PP-12 et PP-230 ne sont pas couverts par la présente garantie.

Tout produit encore garanti qui serait défectueux pour l'une des deux raisons sus-mentionnées sera réparé ou remplacé à la discrétion du fabricant. L'acheteur n'aura pas d'autre recours. Pour nos clients aux ÉTATS-UNIS (territoire continental seulement): Veuillez retourner l'article défectueux suffisamment affranchi à l'usine à l'adresse suivante 301 North MacArthur Blvd., Oklahoma City, OK 73127-6616. Tous les produits garantis retournés feront l'objet d'une inspection détaillée afin de déterminer si la défectuosité est couverte par la garantie. Pour les clients à l'extérieur des États-Unis : étant donné les frais de douane et de transport, il n'est pas économique de retourner la pompe à l'usine pour inspection. Expédier la pompe ainsi qu'une brève description du problème à tout distributeur ou détaillant autorisé. Si elle ne présente aucun signe apparent d'une mauvaise utilisation, elle sera remplacée ou réparée. S'il y a conflit sur la nécessité de remplacer la pompe, le distributeur ou le détaillant devra garder celle-ci et, soit la fera inspecter par un représentant de Little Giant Pump Company, soit avisera l'usine du problème afin de connaître la décision de celle-ci et le règlement de la réclamation.

DÉNÉGATION: LA GARANTIE ÉNONCÉE DANS LES PRÉSENTES EST EXCLUSIVE ET REMPLACE TOUTE AUTRE GARANTIE EXPRESSE OU IMPLICITE; CELA COMPORTE, MAIS NON EXCLUSIVEMENT, TOUTE GARANTIE IMPLICITE D'APTITUDE À LA COMMERCIALISATION OU D'APTITUDE PARTICULIÈRE, POUVANT S'APPLIQUER À UNE POMPE LITTLE GIANT. DE PLUS, ELLE NE S'APPLIQUE QUE DURANT LA PÉRIODE DE COUVERTURE PRÉCISÉE CI-DEVANT.

La présente garantie sera **ANNULÉE** si:

1. Le boîtier scellé du moteur a été ouvert;
2. Le branchement à une tension autre que celle indiquée sur la plaque du fabricant a été effectué;
3. Le fil d'alimentation a été coupé à une longueur inférieure à 0,91 m (trois pieds);
4. La pompe a tourné à vide (l'alimentation en liquide a été coupée);
5. La pompe a été utilisée pour faire circuler des liquides autres que de l'eau fraîche, des huiles légères ou d'autres liquides non corrosifs et ce, à la température ambiante;
6. La pompe a été mal utilisée.

Toute déclaration sur la pompe faite oralement par le vendeur, le fabricant, le représentant ou par toute autre partie ne constitue pas une garantie et, par conséquent, ne peut servir à l'utilisateur. De plus, une telle déclaration ne peut, en aucun cas, faire partie du contrat de vente. L'unique obligation du vendeur et du fabricant, et l'unique recours de l'acheteur, est le remplacement ou la réparation de la pompe selon les modalités décrites précédemment. NI LE VENDEUR NI LE FABRICANT NE PEUVENT ÊTRE TENUS RESPONSABLES DE TOUTE BLESSURE, TOUTE PERTE, OU TOUT DOMMAGE DIRECT, INDIRECT OU ACCESSOIRE (INCLUANT, MAIS NON EXCLUSIVEMENT, LES VENTES OU PROFITS PERDUS, LES ATTEINTES AUX PERSONNES OU À LA PROPRIÉTÉ OU TOUTE AUTRE PERTE INDIRECTE OU ACCESSOIRE) RÉSULTANT DE L'UTILISATION OU DE L'INCAPACITÉ D'UTILISATION DE LA POMPE, ET L'ACHETEUR CONVIENT QU'IL NE DISPOSE D'AUCUN AUTRE RECOURS. L'acheteur doit s'assurer que la pompe convient à l'usage projeté; il assume aussi tout risque et toute responsabilité relativement à cet usage.

Certaines juridictions ne permettent pas la limitation de la durée d'une garantie ou l'exclusion ou la limitation de responsabilité pour des dommages indirects ou accessoires. Par conséquent, il est possible que la limitation ou l'exclusion indiquée précédemment puisse ne pas être applicable. Cette garantie vous donne des droits particuliers et peut-être d'autres, dépendamment des juridictions en vigueur.

Le code national de l'électricité et autres codes semblables d'autres pays exigent l'installation d'un interrupteur avec mise à la terre (GFI) sur le circuit d'alimentation de la fontaine pour toute installation dont la tension est supérieure à 15 volts. Nous offrons de tels interrupteurs (avec différentes longueurs de fil) et nous recommandons que chaque pompe soit reliée à un interrupteur de ce type.

GARANTIA LIMITADA

El producto que Little Giant le ofrece está garantizado a estar en perfectas condiciones al momento de salir de la fábrica. El producto está garantizado contra materiales y fabricación defectuosa por un periodo de 12 meses (una garantía de 90 días para los Modelos: 1-AA-OM, GKPK-SC, PP-1, PPS-1, PP-12, PPS-12, PP-230 y Cooler King) desde la fecha en la cual fue comprada por el usuario. No hay garantía contra el gasto del cepillo del Modelo 35-OM e impulsor o leva en los Modelos PP-1, PP12 y PP-230.

Cualquier producto que falle por alguna de las dos razones anteriores y que esté dentro del periodo de garantía será reparado o reemplazado a opción de Little Giant y éste será el único remedio del comprador. Para nuestros clientes en los ESTADOS UNIDOS CONTINENTALES: Por favor, devolver la unidad defectuosa, con el porte pagado, a la fábrica en 301 North MacArthur Blvd., Oklahoma City, OK 73127-6616. Todo producto defectuoso devuelto bajo la garantía será cuidadosamente inspeccionado para determinar la causa de la falla antes de aprobar la garantía. Para nuestros clientes ubicados en otros lugares; no es económico devolver la bomba a la fábrica para que ésta sea inspeccionada, debido a los impuestos y al flete. Por favor, devuelva la unidad defectuosa a cualquier distribuidor o vendedor autorizado con una breve explicación por escrito del problema. Si no existen señas aparentes de abuso por parte del cliente, la unidad será reemplazada o reparada. Si se produce una disputa sobre el reemplazo de la bomba, el distribuidor o vendedor debe separar los artículos y retenerlos para que sean inspeccionados por un representante de Little Giant Pump Company o avisarle a la fábrica de los detalles del problema para que la fábrica disponga de las acciones necesarias y resuelva el reclamo de la garantía.

DESAUTORIZACION: LA GARANTIA ANTERIOR ES UNA GARANTIA EXCLUSIVA EN LUGAR DE CUALQUIER OTRA GARANTIA EXPRESA. CUALQUIER GARANTIA IMPLICADA (INCLUYENDO PERO NO LIMITADO A CUALQUIER GARANTIA IMPLICADA DE COMERCIALIZACION O APTITUD PARA PROPOSITO PARTICULAR) EN LA MEDIDA EN QUE SE PUEDA APLICAR A UNA BOMBA, QUEDARA LIMITADA EN DURACION A LOS PERIODOS DE GARANTIAS PROPORCIONADOS ANTERIORMENTE.

La garantía será declarada **NULA** si se encuentran cualesquiera de las siguientes condiciones:

1. El alojamiento sellado del motor abierto.
2. El producto conectado a un voltaje que no es el indicado en la placa principal.
3. El cable cortado a menos de tres pies (0,91 m.).
4. Se permitió que la bomba opere en seco (envío de fluido cortado).
5. La bomba empleada para hacer circular cualquier otra sustancia que no sea agua fresca, aceites livianos u otros líquidos livianos aproximadamente a temperatura ambiente.
6. Abuso del producto por parte del cliente.

Cualquier declaración oral acerca del producto hecha por el vendedor, fabricante, representantes o cualquiera de las partes, no constituyen garantías, el usuario no debe confiarse de ellas, y no forman parte del contrato de compra-venta. La única obligación del vendedor y del fabricante y el único remedio para el comprador, será la reposición y/o reparación del producto por parte del fabricante bajo las condiciones descritas anteriormente. NI EL VENDEDOR NI EL FABRICANTE SE HACEN RESPONSABLES DE NINGUNA LESION, PERDIDA O DAÑO, DIRECTO, INCIDENTAL O CONSECUENTE (INCLUYENDO, PERO SIN LIMITARSE A, DAÑOS INCIDENTALES O CONSECUENTES DEBIDO A GANANCIAS PERDIDAS, VENTAS PERDIDAS, DAÑOS A PERSONAS O PROPIEDADES O CUALQUIER OTRA PERDIDA INCIDENTAL O CONSECUENTE), QUE RESULTE DEL USO O DE LA IMPOSIBILIDAD DEL USO DEL PRODUCTO, Y EL COMPRADOR ACUERDA QUE NO EXISTE OTRO REMEDIO DISPONIBLE PARA EL. Antes de usar, el usuario debe determinar si el producto se adapta al uso deseado, y el usuario asume todos los riesgos y responsabilidades en relación a ello.

Algunos estados y países no permiten limitaciones sobre la duración de una garantía implícita o la exclusión o limitación de daños incidentales o consecuentes, de manera que las limitaciones o exclusiones anteriores podrían no tener aplicación en su caso. Esta garantía le da derechos legales específicos, y usted podría disponer también de otros derechos que varían de un estado a otro y de un país a otro.

El Código Eléctrico Nacional (en los Estados Unidos) y códigos similares en otros países requieren un Interruptor de circuito de falla de conexión a tierra (GFCI) para ser instalado en el circuito secundario que suministra equipo de fuente calibrado por encima de 15 voltios. En el almacén se encuentran GFCI de 115 voltios (con varias longitudes de cable), y recomendamos que cada bomba sea usada con un GFCI.

For Parts or Repair, please contact.....1.888.572.9933
For Technical Assistance, please contact.....1.888.956.0000

Pour des Parties ou la Réparation, entrez s'il vous plaît en contact.....1.888.572.9933
Pour l'Aide Technique, entrez s'il vous plaît en contact 1.888.956.0000

Para Partes o la Reparación, por favor póngase en contacto 1.888.572.9933
Para la Ayuda Técnica, por favor póngase en contacto 1.888.956.0000

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Little Giant Print Services

KÜÜL® PADS

SETTING THE STANDARD IN EVAPORATIVE COOLING MEDIA

KÜÜL® evaporative cooling media is manufactured in the USA by Port-A-Cool, LLC

Maintenance Guide

Küül® pads are a durable and long lasting cooling media. Following are suggestions that will maximize the life and efficiency of the cooling pads.

- Port-A-Cool, LLC, recommends that the **pH** of the water be maintained at a **level between 6 and 8**. Exceeding these limits will seriously deplete the resin content of the pad and thus reduce its structural integrity.
- Remove and brush pads with a soft bristled brush and then **flush system to remove debris**. This should be done every 4 to 6 weeks during operating season.

- A **clean water distribution** system is the most important aspect for maintaining the entire evaporative cooling system. This, coupled with quarterly inspection/maintenance checks, will ensure a properly operating evaporative cooling system.
- **Frequently check system** for damaged or clogged cooling pads.
- **Minimize** the number of **on/off wetting cycles** for the cooling pads.
- Completely **dry the cooling pads** once every 24 hours.
- Maintain a **water bleed off** rate of 3-5% per day.
- Ensure sump tank is enclosed and cleaned bi-weekly.
- Clean water filters weekly.

(936) 598-6353 ▪ (800) 231-9940
P.O. Box 2167 ▪ Center, TX 75935 ▪ Fax (936) 598-6328 ▪ www.kuulpads.com ▪ info@kuulpads.com

02/07/2007

KÜÜL® PADS

SETTING THE STANDARD IN EVAPORATIVE COOLING MEDIA

KÜÜL® evaporative cooling media is manufactured in the USA by Port-A-Cool, LLC

Algae Growth and Mineral Build-up: Prevention Guide

Algae Growth

Algae will grow on any surface that is wet and exposed to direct sunlight. Following are suggestions that will aid in the prevention of algae growth on your **Küül® pads.**

- Dry the pads at least once every 24 hours.
- Keep the pads and sump shaded from direct sunlight.
- Use an algaecide (i.e. *Evap 100*™).
- Identify and eliminate sources of nutrients in the water.
- Completely flush system every 4 to 6 weeks during the operating season.
- DO NOT use chlorine at levels that exceed 1ppm (parts per million).

Mineral and Scale Build-up

When water has a high mineral content, scale and mineral deposits form throughout the cooling pad. In order to aid in the prevention of mineral build-up follow these tips:

- Maintain the water at a pH level between 6 and 8.
- Avoid or minimize on/off wetting cycles.
- Use a daily water bleed off rate of 3-5%.
- Use a mineral prevention aid.
- Increase the amount of water flowing over the face of pads.

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Munters

ENGINEERING BULLETIN
EB-WTM-0408

Water Treatment Advice for Industrial Applications with CELdek and GLASdek Equipped Evaporative Coolers

The use; or more accurately, the misuse of water is responsible for the majority of problems reported to Munters relative to media performance and/or longevity. There are three water related problems associated with evaporative coolers, (1) scale, (2) microbiological infestation, and (3) corrosion.

- Scale buildup will foul the media, affect operating efficiency and reduce the service life of the media.
- Microbiological infestation can foul the media and affect operating efficiency. It can also produce objectionable odors downstream, reduce the service life of the media, and induce corrosion of system metal.
- Corrosion will reduce the service life of the framing, sumps, piping, and support systems.

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SCALE CONTROL

Rule:
Water treatment is for the media, where the evaporation occurs.

Standard Water Treatment Controls and Philosophies

Standard cooling water treatment controls and philosophies were developed for scale control of heat exchange equipment where there are high flow rates and high velocities, and no evaporation (the evaporation occurs at the cooling tower).

Because with evaporative coolers and humidifiers, the evaporation occurs at the media surface, standard water treatment practices do not apply. The primary control method is to provide sufficient water to the media to keep it flushed. If sufficient water is not provided to completely wet and flush the entire surface, deposition will occur.

Minimizing Water Problems

Many water related problems can be avoided if good system design and basic housekeeping practices are followed. However, water treatment chemicals should not be used in place of following these practices:

1. Provide good, even water distribution, (1 .5 GPM per square foot of top surface area) from one end of the pad, to the other.
2. Correct any source of water carry over to eliminate unwanted water droplets outside of the pad area. Do not just restrict the water flow as this may cause other problems.
3. Adequate bleed off is the simplest form of scale control (See Page 5).
4. Clean and flush distribution headers on a regular basis.
5. Consider constructing shorter pad walls if scaling is a problem (i.e., two banks five foot high instead of one bank ten feet high).
6. Replace damaged or spent media.
7. When media experiences extreme evaporation, a flush cycle should be provided every 24 hours - with the air flow off.

Silt may eventually clog the distribution headers. Periodic flushing of the headers should remedy this situation.

Scaling Indices

It has been estimated that calcium carbonate makes up one-fifth of the earth's crust. In the majority of evaporative cooling waters its solubility has to be considered. The scaling tendencies of calcium carbonate are usually calculated through the use of scaling indices. The Langelier, Ryznar, or Puckorious (Practical Scaling) indexes are best known. The Puckorius Scaling Index is the latest technology and can be calculated from the following table:

Table 1. Rapid Calculations of Puckorius Scaling Index for Evaporative Coolers

Conductivity (micromhos)	"A"	Calcium Hardness (ppm as CaC03)	"C"	Total Alkalinity (ppm as CaC03)	"D"	Total Alkalinity (ppm as CaC03)	pH_{eq}
50-300	0.1	10-15	0.70	10-15	1.10	50	7.0
301-1000	0.2	16-25	0.90	16-25	1.30	100	7.5
1001-3000	0.25	26-40	1.10	26-40	1.50	200	7.9
3001-5000	0.27	41-70	1.35	41-70	1.75	300	8.2
		71-100	1.55	71-100	1.90	400	8.4
Temperature (F)	"B"	101-140	1.70	101-140	2.10	500	8.5
		141-200	1.85	141-200	2.25		
		201-250	1.95	201-250	2.34	Notes:	
50-56	2.3	251-300	2.05	251-300	2.45	Approximate Conversion:	
57-62	2.2	301-350	2.12	301-350	2.52	Conductivity= 1.58 x TDS	
63-70	2.1	361-400	2.18	351-400	2.58	Water temperature is generally	
71-80	2.0	401-450	2.24	401-450	2.63	the wet bulb temprature of the air	
		451-500	2.28	451-500	2.68		

Computer routines for calculating the PSI are also available online at www.puckorius.com

INSTRUCTIONS FOR USING TABLE 1

(1) Obtain values of A, B, C, and D from Table 1
(2) $pH_S = (9.3 + A + B) - (C + D)$
(3) Puckorius Scaling Index = $2\ pH_S - PH_{eq}$

EXAMPLE

Find the Puckorius Scaling Index at of 70° F water which has the following characteristics:
Conductivity = 700 µmhos
Calcium hardness as $CaCO_3$ = 306 ppm, Alkalinity as $CaCO_3$ = 234 ppm, then:
Conductivity = 700 µmhos = 0.2 (from A)
Temperature = 70° F. = 2.1 (from B)
Calcium Hardness as $CaCO_3$ = 306 ppm = 2.12 (from C)
Alkalinity as $CaCO_3$ = 234 ppm = 2.34 (from D)

PH_{eq} (based on Alkalinity of 234 ppm) = 8.0
$pH_s = (9.3 + 0.2 + 2.1) - (2.12 + 2.34) = 7.14$
PSI = 2(7.14) - 8 = 6.26

CALCULATING OTHER SCALING INDICES

Table 1 can also be used to calculate the Langlier and Ryznar indices as follows:
(1) Use the actual pH of the water in place of pH_{eq}
(2) Calculate the pH_s using Table 1
Ryznar (RSI) = $2\ pH_s$ - pH
Langlier (LSI) = pH - pH_s

After the cycles of concentrations have been established for a given make-up water source, the next step is to determine the amount of bleed-off required to maintain the desired cycles of concentration. See page 6.

PSI Results			
5.0	Severe Scaling	6.0	Stable Water
5.5	Moderate Scaling	6.5	Very Slight Scale Dissolving
5.8	Slight Scaling	7.0	Slight Scale Dissolving

THE IMPLICATIONS OF SCALING

The harshest use for CELdek and GLASdek media is automotive spray booth humidification. Here, for example, the cold dry winter air is heated to 120° F, 5% RH and evaporatively cooled to 75° F and 80% RH ± 2%. To achieve this type of control, the water is pulsed on and off many times per minute. It is a constant problem to maintain adequate flushing and good non-scaling conditions. When sections of the media do not receive sufficient water flow, severe deposition occurs.

This deposition may block the flow of air, causing bowing of media, especially when sufficient support is not provided. Bowing will allow media to fall out of the framing, which reduces the service life of surrounding media.

Severe deposition may also result in highly localized, elevated pH levels at the interface of the surface of the media and the scale. This can lead to leaching of the stiffening agents and therefore, premature failure of the media.

As a result, the initial step in scale control is to provide sufficient water flow over a minimum recommended time span. When this minimum recommended time span cannot be provided due to temperature/ humidity requirements and/or evaporative cooler design, a daily flush cycle should be provided. This daily flush cycle (generally two minutes per foot of media height) will dramatically increase the service life of the media. The flush cycle works best if it is done at the conclusion of the daily production or cooling cycle.

This same maintenance philosophy can be applied to other applications where severe deposition is a problem.

Problems Associated with Scale Formation

There are three (3) predominant problems associated with heavy scale formation in evaporative cooling units:

1. Decreased airflow through the unit due to plugging of the media.
2. Decreased evaporation surface area.
3. Deterioration of the media relating to localized high pH conditions that leach the stiffening agents and degrade the paper.

Programs for Scale Control

There are three (3) programs for preventing the formation of calcium carbonate scale in evaporative cooling units:

Poor water distribution and inadequate flushing quickly shorten the life of the system.

1. Remove the calcium hardness through a pre-treatment unit demineralizees, reverse osmosis, etc.
2. Maintain a slightly scale dissolving calcium carbonate index.
3. Assist the previous two methods with chemical treatment addition; using a crystal modifier type of treatment.

NOTE: All the above procedures still require that sufficient water be provided to completely wet the media and flush deposits from the media surface.

Scaling Indicaters

After sufficient water flow has been provided to the media, the scaling tendency of the recirculating water should be established.

Scale formations occur when soluble salts are precipitated and deposited from the recirculating water. The rate of formation depends mainly on:

1. Temperature
2. Alkalinity or acidity
3. The amount of scale-forming material in the recirculating water

BLEED-OFF
(Cycles of Concentration)

Makeup water is added to the sump to replace the water lost through evaporation. Since this makeup water contains dissolved minerals, the mineral content of the recirculating water gradually increases. Dividing

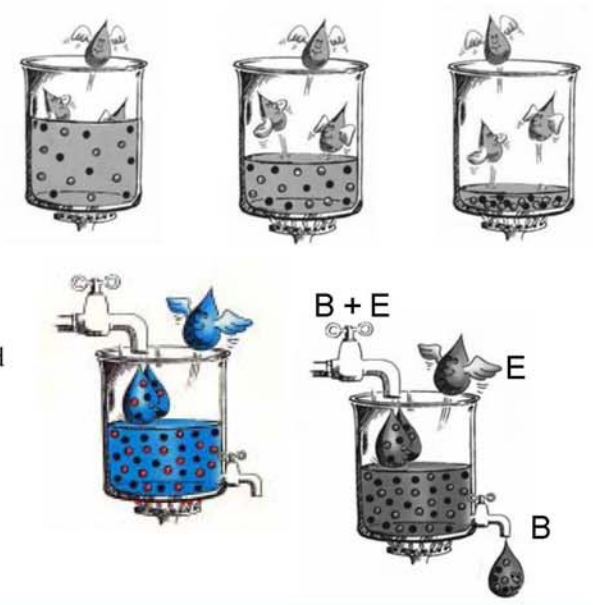
Basics of Water Evaporation

Water always contains a certain amount of dissolved minerals. When evaporation takes place, the mineral concentration in the recirculated water will increase.

In order to compensate for the evaporated water, fresh water must be supplied.

To avoid build-up of insoluble minerals on the pad surface (scaling), causing increase in pressure drop, some of the recirculating water must be discharged and replaced with fresh water. The relation between the discharged water, B, here referred to as "bleed-off", and evaporated water volume, E, is indicated as B/E ratio. The "bleed-off" volume of water depends on the water quality.

Water losses by evaporation and "bleed-off" must be replaced by continuously adding fresh water.



the concentration of the minerals in the recirculating water by the same concentration of minerals in the makeup water gives a ratio that is referred to as "cycles of concentration."

Example:
Recirculating water conductivity: 800 µmhos
Makeup water conductivity: 200 µmhos
Cycles of concentration:= 4 cycles.

To maintain cycles of concentrations in the recirculating water, a bleed-off is provided to remove a given portion of the recirculating water whenever cycles of concentration surpass the upper limits based on the "Puckorius Scaling Index".

Based on tests performed and operating evaluations of various systems, Munters has established the following index range for operation of evaporative cooling systems:

Langelier Index = 0.5 ± 0.25
Ryznar Index = 6.0 ± 0.5
Puckorius Index = 6.5 ± 0.5

After the cycles of concentrations have been established for a given makeup water source, the next procedure is to determine the amount of bleed-off required to maintain the desired cycles of concentration.

The amount of bleed-off required is determined from the following formula:

$$\text{Bleed-Off} = \frac{\text{Evaporation}}{(\text{Cycles} - 1)}$$

Munters has developed the following formula for determining the evaporation rate for an evaporative cooler. The formula is not as accurate as using a psychometric chart however, it is easy to use and accurate within ± 10%.

$$\text{Evaporation} = \frac{1.2 \times \text{CFM} \times (\text{EDBT}-\text{LDBT})}{10{,}000}$$

Bleed-off = Gallons per hour
Evaporation = Gallons per hour
CFM = Standard Cubic Feet Per Minute of Air
EDBT = Entering Dry Bulb Temperature (°F)
LDBT = Leaving Dry Bulb Temperature (°F)

Example:

To find the evaporation and bleed-off requirements of an evaporative cooler with the following characteristics:
CFM = 50,000, EDBT = 110° F, LDBT = 75° F, cycles of concentration = 4, then:

$$\text{Evaporation} = \frac{1.2 \times 50{,}000 \times (110-75)}{10{,}000} = 210 \text{ GPH}$$

$$\text{Bleed-off} = \frac{210 \text{ GPH}}{(4-1)} = 70 \text{ GPH}$$

To take this example one step further, the total makeup requirements of the evaporative cooler can be determined as follows:

Makeup = Evaporation + Bleed-off
= 210 + 70 = 280 GPH

NOTE: When sizing makeup requirements for an evaporative cooler always use the evaporation and bleed-off requirements for highest design criteria.

Silicates

Silicates form a number of different scale complexes with calcium, magnesium, aluminum, sodium, and iron.

The usual control procedure is to maintain the silica level (as SiO_2) in the recirculating cooling waters below 100 PPM. In most parts of the country this presents no problem and at least 4-5 cycles of concentration can be attained, based on silica content. However, in some southwestern areas, it is not unusual for raw water silica (as SiO_2) levels to reach 60-90 PPM. This severely restricts the cycles of concentrations that can be attained. Munters recommends that silica levels in the recirculating water be controlled below 100 PPM in the bulk water because it will be substantially higher in areas of intense evaporation.

Maintain Slightly Scale Dissolving Calcium Carbonate Index

This approach is the most economical and maintenance-free method of scale control. It requires only an acceptable method of controlling cycles of concentrations. This eliminates costly capital expenditures for pretreatment units, their regenerate costs and maintenance of the units. The use of this method is only restricted by the makeup water quality.

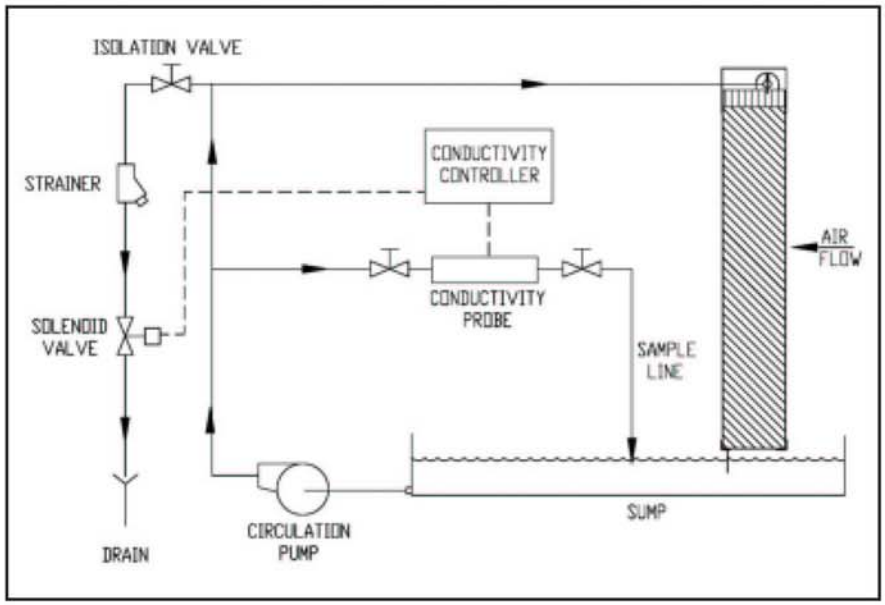
Controlling Cycles of Concentration

There are various methods of controlling a bleed-off to maintain the desired cycles of concentration in the evaporative cooling system. The simplest is to install a valve on the pressure side of the pump and continuously run a predetermined stream of water to drain whenever the pump is activated. Unfortunately, this procedure does not allow for any fluctuations in the system. Evaporative cooling systems fluctuate constantly due to outside temperature and humidity conditions. These fluctuations can be compensated for by controlling the bleed-off based on the conductivity of the water. This is accomplished by installing a conductivity controller in the system. It continuously measures the conductivity until the measurement surpasses the desired set point. It then opens a solenoid valve and bleeds off system water until it is back within control range.

This is the only practical continuous control method. Reliable conductivity monitoring equipment, along with assistance in installing the equipment and operating instructions, can be obtained from your water treatment service company.

Using Bleed-Off

There are various methods of controlling bleed-off to maintain the desired cycles of concentration in the evaporative cooling system. The simplest is to run a side stream off the pressure side of the recirculating pump. Installing a flow meter at the point of bleed-off will help maintenance personnel monitor and set the bleed-off rate. The amount of water bled-off in this manner is normally calculated using worst case scenario. Unfortunately, this method does not allow for any fluctuations in evaporation rates and often wastes water.



Typical Layout for Conductivity Controller

Dump Cycles

Dumping the entire contents of the sump is an effective way to remove contaminants and debris from the sump. It is also an effective alternative or enhancement to a conventional bleed-off system. A continuous bleed will not remove silt and organic matter which accumulates in the bottom of the sump. Dump cycles should be commensurate with organic and particulate contamination to the system and must be determined on an individual basis. Dump cycle frequency varies as shown in the following examples:

- Systems with municipal water and no other source of bleed may need to be dumped twice each day.
- Systems having high purity water and no bleed may need to be dumped once each quarter.
- Systems with a regular bleed with a clean source of air and water may need to be dumped once each year.
- Systems having regular bleed and heavy contaminant loading may need to be dumped once each week or month.

Once-Through Water

Many industrial applications use once-through water for the evaporative cooler. While not a recommended procedure, when this practice is utilized the following guidelines should be followed:

1. If the raw water supply has a Puckorius Scaling Index in the excess of 8.0; reduce the water flow to 0.75-1.0 GPM per square foot of top media surface area. When using a reduced flow rate contact Munters for optimum pipe size, hole size and spacing.

2. If raw water supply has a Puckorius Scaling index of 5.5-8.0, use normal recommended water flow rates.

Chemical Treatment

The recommended treatment approach is the use of crystal modifiers: such as, sulfonated polystyrenes and polymaleic acid. This program allows scale to form, but the chemical additives distort the resulting crystal structure, changing the scale to a non-adherent sludge.

Tests performed at Munters, along with actual field experience indicate that this program produces a deposit that is easy to flush from the media surface.

Crystal modifiers help to form a soft sludge rather than a hard scale. It is necessary to flush the system with water to remove the sludge.

Chemical Treatment Control

Proper chemical residuals must be maintained in the system. The chemical feed systems; control limits and monitoring requirements should be established with your water treatment service company. Their recommended control procedures must be followed for successful operation.

HIGH-PURITY WATER

Each site will have its own water quality standard and may require some pretreatment of the raw water source to meet their needs. There is a variety of water qualities available.

Water pretreatment systems at industrial sites often employ membrane technology (reverse osmosis) and/or a demineralizer. The resulting high purity water supply may be required for some processes. It is not recommended as "once through" on non re-cycled water for evaporative coolers.

Characteristics of High Purity Water
Corrosive to many metals
Causes media to soften
Has a low pH

Successful Use of High Purity Water.

High purity water has been used successfully in many CELdek® and GLASdek® installations. Success depends upon cycling up the water as much as possible. Continuous bleed-off must not be used. It is very beneficial to elevate the system pH to 7.5 - 9.0. This adjustment will enhance media longevity and reduce the corrosivity of the water. Often the pH will increase on its own without the need for chemical addition.

All piping and fittings between the water purification facility and the makeup for the evaporative cooler must be plastic or stainless steel. Components of the evaporative cooler recirculating loop, sump and overflow must be corrosion resistant but will not be as susceptible to corrosion because the high purity water becomes more concentrated in the system.

Stop all water leakage including unintentional overflow. Examine makeup valves, drain valves and water level control to make certain the system is water tight. Make certain drift eliminators, when used, are functioning properly and their collection trough drains back into the evaporative cooler sump. Monitor the conductivity of the recirculating water to verify that the water is actually cycling up.

It will not be necessary to continuously monitor the quality of the water once a trend is established. However, the water should never be allowed to exceed the maximum constituent levels set by Munters.

Although the water introduced to the evaporative cooler will be very clean, the air will introduce a significant amount of contamination over time. This contamination will be in the form of particulate, soluble gasses, nutrients and microbial spores. It will be necessary to inspect the sump weekly to determine if these contaminants should be removed from the system via a dump cycle. The frequency of dump cycles will be a function of the contaminant loading at the site.

The uncontrolled use of this high purity water is discouraged for the follow reasons:

1. High purity waters will accelerate corrosion of common metals used in the evaporative cooler.
2. Non- recirculated high purity waters will have a deleterious effect on the stiffening agents used in the manufacturing process of CELdek as well as GLASdek evaporative cooling media.
3. Misuse of this type of water could result in a significant reduction in media longevity.

The capital expenditures to purchase and install a pretreatment system capable of providing makeup water for maximum evaporation and bleed-off requirements may be excessive. It is probably more cost effective to design a smaller pretreatment system and blend the effluent with raw water. This would permit the user to obtain a makeup water quality with acceptable recirculating water cycles of concentration. These designs will be limited by the raw quality and availability.

Blending Treated and Raw Water

A blend of treated water and raw water is very appealing when the raw water has a high silica content in areas of limited make-up water, and in locations where water use restrictions exist.

Example: Obtain the cycles of concentration, bleed-off, and make-up requirements for the following situation, then calculate the optimum cycles of concentration using a 50% blend of raw and reverse osomosis water:

CFM = 80,000

Entering Dry Bulb Temperature = 95° F

Leaving Dry Bulb Temperature = 70° F

Water Supplies:

Component	Raw Water	Treated Water
Calcium Hardness (as $CaCO_3$)	195 PPM	1.5 PPM
Total Alkalinity (as $CaCO_3$)	105 PPM	11 PPM
Silica (as SiO_2)	73 PPM	1 PPM
Temperature	70 F	70 F
Conductivity	1000 µmhos	30 µmhos

$$\text{Evaportation} = \frac{1.2 \times 80{,}000 \times (95-70)}{10{,}000} = 240 \text{ GPM}$$

50% blended water (approximate analysis):

Calcium Hardness (as $CaCO_3$)	100 PPM
Total Alkalinity (as $CaCO_3$)	60 PPM
Silica (as $Si0_2$)	37 PPM
Conductivity	500 µmhos
Temperature	70° F
pHeq	7.1

At four (4) cycles of concentration (approximate analysis):

Calcium Hardness (as $CaCO_3$)	400 PPM
Total Alkalinity (as $CaCO_3$)	240 PPM
Silica (as $Si0_2$)	148 PPM
Conductivity	2000 µmhos
Temperature	70° F
pHeq	8.0

At four (4) cycles of concentration the Puckorius Scaling Index calculate as follows:

pHs = (9.3 + .25 + 2.1) - (2.18 + 2.34) = 7.13

Puckorius Scaling Index = 14.26 - 8.0 = 6.26

$$\text{Bleed-off} = \frac{\text{Evaporation}}{(\text{Cycles} - 1)} = \frac{240}{(4-1)} = 80 \text{ GPH}$$

Make-up = Evaporation + Bleed-off

=240 + 80 = 320 GPH

Munters Tables for Quick Selection of Cycles of Concentration

Table No. 2 (Low Hardness)		Table No. 3 (Moderate Hardness)	
COMPONENT	ANALYSIS	COMPONENT	ANALYSIS
Total Hardness	60-100 PPM	Total Hardness	100-140 PPM
Total Alkinity	30-60 PPM	Total Alkalinity	60-80 PPM
CYCLES 4 - 6		CYCLES 3 - 4	
Table No. 4 (Moderate-High Hardness)		Table No. 5 (High Hardness)	
COMPONENT	ANALYSIS	COMPONENT	ANALYSIS
Total Hardness	140-1 80 PPM	Total Hardness	180-220 PPM
Total Alkalinity.	80-120 PPM	Total Alkalinity	120-150 PPM
CYCLES 2.5 - 3.0		CYCLES 2.0 - 2.5	

Tables 2 through 5 were developed to select the cycles of concentration for a recirculating water system.

Locate the table that corresponds with the total hardness (as $CaCO_3$) and total alkalinity (as $CaCO_3$) of the make-up water of the system. If the make-up water is in the lower range of the table, use the higher cycles; conversely, if it is in the higher range, use the lower cycles. If the make-up water does not correspond with one of the tables, or if the silica (as SiO_2) content is >25 PPM, call Munters for advice at (239) 936-1555.

BIOLOGICAL FOULING

Uncontrolled growth of organic matter can lead to plugged media, metal deterioration, and undesirable odors downstream in the air supply.

Any of the above problems will produce undesirable results in plant operation and/or environment. Therefore, an effective program to control algae, bacteria, fungi, molds and yeasts is an essential part of any water treatment program.

Individual locations will have different problems depending on makeup water source, airborne contaminants and the plant environment, e.g., location of nearby stacks emitting organic compounds.

A biocide program should be implemented in conjunction with the water treatment service company to provide effective control of the microbiological problems. However, biological control should not be used in place of good housekeeping.

Control Approaches

Chemical protection of systems for microbiological control falls into two categories: (1) oxidizing biocides, and (2) non-oxidizing biocides.

Oxidizing Biocides

Oxidizing biocides are not recommended for use in evaporative coolers or humidifiers containing CELdek or GLASdek . Any chemical that is an oxidizing agent is an oxidizing biocide. These products "burn" the organisms and destroy the nutrient as well. They are very unstable and have a short residence time in the system.

The two most commonly used oxidizing biocides are chlorine and bromine. These chemicals have widespread success in general application; however, they can soften and destroy CELdek and GLASdek media.

Non-Oxidizing Biocides

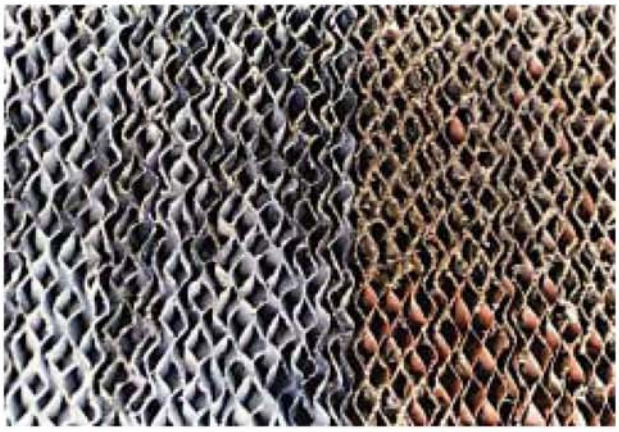
Any chemical that is not an oxidizing agent but is toxic to one or more classes of microorganisms is classified as a non-oxidizing biocide.

Non-oxidizing biocides offer another means of controlling microbial activity in evaporative cooling systems. They provide the following features:

1. Effective over a wide pH range
2. Persistent - they remain in the system
3. Control a broad range of organisms such as fungi, bacteria, algae, molds and yeasts.

There are many proprietary products available from water treatment service companies. The selection of a non-oxidizing biocide is often based on the personal experience of the water treatment service representative with similar systems. Microbiological plate counts should be used to effectively monitor results.

Most evaporative coolers have small system water capacities and overdosing the system with chlorine and/or bromine can occur quite easily.



Mi-T-edg No Mi-T-edg

Munters recommends Mi-T-edg or TUFedg treatment to reduce algal and microbial growth

RECOMMENDED CHLORINE/BROMINE DOSAGES	
Continuous Treatment	Not recommended
Shock Treatment*	1.0 to 5.0 PPM Free Halogen

*Not recommended more than once per quarter

Biocide Selection

There are many factors involved in the proper selection of a biocide. However, there is one factor that should always be considered in the selection process. The pH of the recirculating water is extremely important in determining the effectiveness of the product. Some biocides lose their effectiveness at a pH above 8.0, while others work best in an alkaline environment.

An effective biocide program includes the use of an effective disinfection program in combination with the biocide. Reduction of the active (living) microbial population is not enough. This reduction should be coupled with a system to remove the "dead" microbial population entirely so they do not serve as a nutrient sources.

pH limitations of the more commonly used biocides:

Less Effective Above 8.0	Effective Over Broad pH Range
Chlorine	Bromine
DBNPA (2,2 Dibromo-3 Nirtilo Propionamide)	Isothiazolin
Methylene Bis-thiocyanate	Carbamates
Copper Salts	Quatenary Ammonium

Housekeeping

All too often, the major influence on microbial growths, odors, etc., is the lack of an effective, consistent housekeeping program (quarterly) of the sumps and surrounding areas. Other factors could have considerable impact on reducing these problems:

1. Algae, bacteria, and fungi cannot proliferate without nutrients. Check for sources and attempt to eliminate or control them: i.e. Organic emissions from nearby stacks. Farm fields, pollen, organic dust or fertilizer. Surface water and shallow wells. Phosphate type scale inhibitors.
2. Algae cannot grow without a source of light Shade the media and sump if exposed to sunlight make certain lights inside of the air house are turned off.
3. Algae, bacteria and fungi need moisture to live. Make certain that the bottom of the pads are not touching the water especially when the system is turned off.

Allow the pads to dry out every twenty-four hours. Pads located inside of an air house may need some mechanical ventilation to dry.

Systems experiencing these outside influences will need to be flushed and cleaned more often than others. Pre-filters will provide shade and can remove some of the airborne particulate contaminants. A bleed-off will keep nutrients from concentrating in the recirculating water.

Recommended Best Practices

1. Maintain conventional slime and algae control in accordance with standard, effective water treatment practices. Maintain overall system cleanliness.
2. Thoroughly clean and flush the entire cooling water loop on a regular basis (minimum annually). Include disinfection before and after cleaning.
3. Consider regular elevated disinfection at extended contact times during routine operations (once per quarter).
4. Maintain best available mist elimination technology.
5. Do not locate the inlet of an evaporative cooler near the outlet of a cooling tower.
6. Routine testing with Bioscan meter for Relative Population Density (RPD) less than 10^4 colonies.

CORROSION CONTROL

Corrosion control in evaporative coolers requires the following:

- Knowledge of metals used in the system.
- Awareness of their susceptibility to corrosion under system operating conditions.
- Familiarity of chemicals used for corrosion control.

Corrosion is the result of the oxidation of metal by some oxidizing agent in the environment. The area over which the metal is oxidized is called the anode and at which the oxidizing agent is reduced is called the cathode.

The areas are separated, but usually are not far apart. As corrosion occurs, electrons flow between these areas through the solution and through the metal itself. This system constitutes a galvanic cell.

Three basic types of corrosion occur general, pitting and galvanic. General attack is a term that describes the general distribution of corrosion over the entire metal surface.

Pitting attack occurs when isolated metal areas are corroded. Pitting is the most serious type of corrosion because all the corrosive action occurs in a very small area Pitting attack can perforate metal in a short period of time. Pitting usually occurs when small anodes are coupled with large cathodes.

Galvanic attack occurs when two different metals are in physical contact In such a case, the more active (anodic) metal corrodes rapidly. Common examples of galvanic attack in water systems include the following combinations: steel and brass, aluminum and steel, zinc and steel, iron and stainless steel, and zinc and brass. In each case, the first metal of the pair will corrode.

Material Selection

In designing evaporative coolers, it is recommended that close attention be given to the galvanic series.

GALVANIC SERIES

Active, Corroded End(Anodic, or least noble)

Magnesium
Zinc
Aluminum
Miki Steel
Steel Alloys
Cast Iron
Stainless Steel (active)
Lead
Tin
Brasses
Copper
Bronzes
Copper-Nickel Alloys
Nickel
Inconel
Stainless Steel (passive)
Titanium

Protected End (Cathodic or most noble)

Metals near the top of the series suffer corrosion when coupled with those nearer the bottom. Galvanic couples of metals closer in the series usually corrode more slowly than couples that are farther apart.

Material selection is the preferred method of corrosion control in evaporative coolers. This has been recognized in the industry and as a general rule, corrosion resistant materials have been utilized.

Chemical Control of Corrosion

The need for a corrosion inhibition program may occur; especially in large central recirculating systems such as those that are used in the automotive industry. In these cases, Munters recommends the following:

1. Avoid phosphates, as they will increase scale deposition.
2. The first consideration should be an all-organic treatment program since it combines scale and corrosion inhibition.
3. When a more effective steel corrosion inhibitor is required, use molybdate.
4. Confer with a water treatment service company for recommended programs for the system.
5. Establish a corrosion-monitoring program utilizing representative corrosion coupons.

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The data and suggestions contained herein are based on information Munters believes to be reliable. They are offered in good faith, but without guarantee, as conditions and methods of use are beyond our control. We recommend that the prospective user determine the suitability of our media and suggestions before adopting them on a commercial scale.

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